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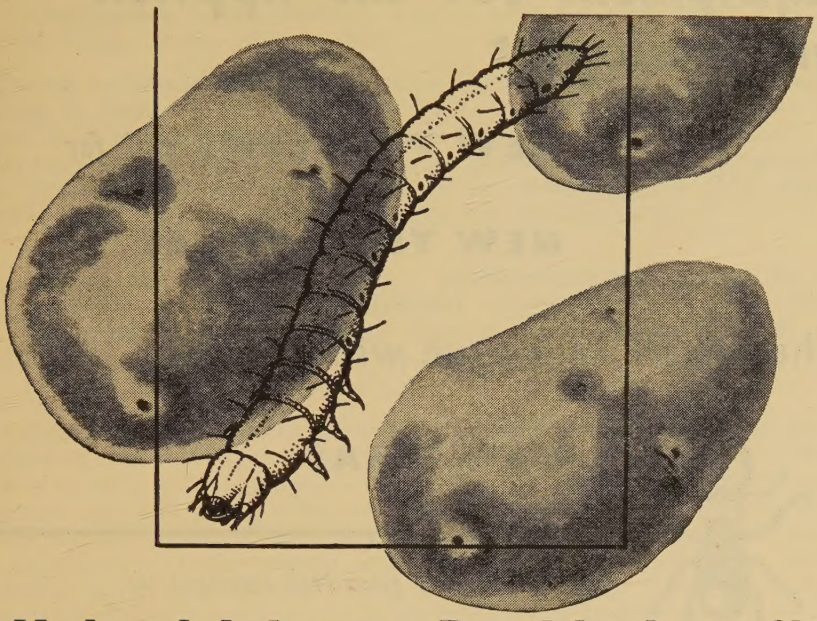

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Aizawa (K.), Asahina (S.) & Fukumi (H.). **Demonstration of the Polyhedral Diseases of *Euproctis flava* and *Euproctis pseudoconspersa* (Lepidoptera, Lymantriidae).**—*Jap. J. med. Sci. Biol.* **10** no. 1 pp. 61–64, 2 figs., 2 refs. Tokyo, 1957.

During outbreaks of *Euproctis flava* (Bremer) and *E. pseudoconspersa* Strand in Japan in the summer of 1955, the larvae of both moths were found to be attacked by a polyhedral virus disease of the nuclear type. The symptoms are described, and the name *Borrelina dokuga* is proposed for the virus. It did not prove infective for *Bombyx mori* (L.), *Galleria mellonella* (L.) or *Hyphantria cunea* (Dru.) in injection tests.

Fjelddalen (J.) & Stenseth (C.). **Spesialmidler mot midder for bekjempelse av egg av frukttremidd (*Metatetranychus ulmi* Koch).** [Acaricides for the Control of Eggs of the Fruit-tree Mite (*M. ulmi* Koch).]—*Frukt og Baer* **10** pp. 77–81, 1 fig., 5 refs. Oslo, 1957. (With a Summary in English.)

Acaricides with a special ovicidal action were tested in the field for the control of *Metatetranychus ulmi* (Koch) on apple in Norway in 1953–56. When a single spray application was made at the post-blossom stage against summer eggs and young mites, complete control for at least five weeks was given by an emulsion concentrate containing 20 per cent. chlorbenside (p-chlorobenzyl p-chlorophenyl sulphide), used at 0·07 per cent., and by wettable powders containing 20 per cent. chlorbenside or Tedion (2,4,5,4′-tetrachlorodiphenyl sulphone) or 50 per cent. fenson (p-chlorophenyl benzenesulphonate), the first used at 0·15 per cent., the second at 0·1 per cent., and the third at 0·08 and 0·1 per cent. of the formulation. In a comparative test, 50 per cent. methyl-demeton [dimethyl 2-(ethylthio)ethyl phosphorothioate], used at 0·05 per cent., gave equally good results. Against the winter eggs, treatment proved more effective at the green-cluster than at earlier or later stages. Fenson at 0·1 per cent. and chlorbenside at 0·25 per cent. of the wettable powder both gave excellent control, and doubling the concentration of the former did not prolong its residual effect. Both were superior to DNC in oil emulsion applied at bud-burst. Tedion proved ineffective. None of the materials injured the trees.

Sial (N. M.). **The Earwig as an Orchard Pest.**—*Fruit Yearb. 1958* pp. 140–145, 11 refs. London [1957].

The author shows from a review of the world literature that the omnivorous feeding habits of *Forficula auricularia* L. render it injurious or beneficial according to circumstances. It sometimes attacks living insects, but also injures farm and garden crops, and has recently been recorded as damaging apples in England [*cf. R.A.E.*, A **40** 143]. Little information is available as to the size of earwig populations in market gardens or fruit plantations, but trapping in apple orchards in south-eastern England indicated the presence of 400–600 per acre, or about one per two apple trees, in the spring of 1956, and of about 12,000 per acre at the end of June, when the observations were discontinued. Higher numbers could be expected in August and September, when the risk to fruit crops is greatest.

Fruit Tree Spraying.—*Bull. Minist. Agric.* no. 5 (5th edn.), iv + 32 pp., 8 pls., 9 figs. London, H.M.S.O., 1957. Price 3*s.* 0*d.*

This bulletin on commercial orchard spraying in England is a revision of an earlier edition [*R.A.E.*, A **28** 4] and supersedes a shorter one that

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replaced it temporarily [**32** 73]. It contains information on the general organisation of spraying operations, the various types of spray machines available for different conditions, the choice, adjustment and maintenance of hoses, lances, nozzles and other fittings, the general maintenance of spray equipment, and methods of using it for maximum efficiency. Methods of calculating the output and tractor speed required for the application of a given quantity of spray from an automatic sprayer are given in an appendix.

D'Aguilar (J.), Gérard (J. L.) & Lhoste (J.). **Données sur l'action de l'heptachlore appliqué en traitement du sol contre les larves d'Elateridae.**—*Phytiat.-Phytopharm.* **5** no. 1 pp. 3–8, 6 refs. Paris, 1956.

Soil treatments with heptachlor, chlordane and aldrin were tested in north-western France against wireworms of the genus *Agriotes* in two potato fields each containing about 400,000 wireworms per acre in early March. Dusts were applied in mid-April, before planting, and tubers were examined for wireworm injuries after harvest in September. Samples of 1,500 were taken from the first field, and the numbers uninjured were 1,480 and 1,371 for heptachlor and chlordane at 4·5 and 6·3 lb. toxicant per acre, respectively, and 217 for no treatment. The highest numbers of injuries per tuber were 4 and 9 for the two treatments, respectively, as compared with over 15 in the controls. Of samples of 1,600 tubers examined from the second field, 1,468 and 1,355 were uninjured after treatment with heptachlor and aldrin, respectively, at 3·6 lb. per acre, and 1,032 after no treatment. The highest numbers of injuries per tuber were 7 and 9 for heptachlor and aldrin, respectively, and more than 15 in the controls. The flavour of the tubers was not affected by the insecticides.

Viel (G.) & Chancogne (M.). **Sur les propriétés insecticides des dérivés de l'acide phénoxycyclopropane carboxylique.**—*Phytiat.-Phytopharm.* **5** no. 1 pp. 21–26, 4 refs. Paris, 1956.

In view of the recent synthesis of esters of p-chlorophenoxycyclopropane carboxylic acid, tests were carried out on their insecticidal effects. The main tests were made by treating petri dishes with 3 cc. ether solution and confining adults of *Calandra granaria* (L.) for 24 hours on the dry deposits, after which the weevils were removed to untreated wheat and observed for mortality after a further 24 hours. It was found that the acid itself was inactive at 2 per cent. Its ethyl ester showed a median lethal concentration of 0·35 per cent., and similar results were given when the alkyl chain was lengthened up to C_{10}, but increasing it still further led to a diminution of toxicity. When various substituents on the benzene ring of the ethyl ester were compared, chlorine was the best, and it was more effective in the para than in the meta or ortho position. Ethyl p-chlorophenoxycyclopropane carboxylate was less toxic to the weevil than pyrethrins or allethrin in similar deposit tests, and it was much less toxic than these to adults of *Musca domestica* L. when tested in deposits or aerosols. In sprays against *Aphis fabae* Scop., it gave 80 per cent. kill at 1 per cent., as compared with 87·5 per cent. kill at 1 per cent. for allethrin and 75·5 per cent. for γ BHC at 0·01 per cent.

Viel (G.) & Coulon (J.). **Remarques sur l'influence de composés lipidiques sur les doses léthales du gamma HCH dans les essais biologiques.**—*Phytiat.-Phytopharm.* **5** no. 1 pp. 27–31, 1 ref. Paris, 1956.

Bioassay using *Drosophila melanogaster* Mg. is a sensitive method of determining residues of BHC or its γ isomer, but its accuracy is upset by the

presence of animal or vegetable extracts in the films to which the flies are exposed [*cf. R.A.E.*, A **41** 70]. The investigations described were concerned with the effect of lipids on the accuracy of the test, and they were carried out by exposing batches of 25 adults of *D. melanogaster* in closed petri dishes to filter papers 9 cm. in diameter bearing residues from 1 cc. solution. When technical BHC was used alone, the percentage mortality in two hours rose from 7·8 for deposits of 0·31 μg. per sq. cm. to 100 for 3·1 and 6·2 μg., but it was 0 after 12 hours for all rates of deposit when ether extracts were prepared from the same amounts of BHC added to 20 g. flour. To ascertain whether this inhibition was due to the lipid constituents of the extracts, the filter papers were impregnated with γ BHC at 1·6 μg. per sq. cm. alone or with the addition of 1·6 mg. groundnut oil. The first gave complete mortality in an hour, whereas the second gave none in an hour and an estimated 75 per cent. in 20 hours, when mortality in the untreated controls was already high. When the first test was repeated with deposits of technical BHC to which groundnut oil had been added at 0·8 mg. per sq. cm., mortality in two hours was quite irregular, and the highest (4·5 per cent.) was given by BHC at the lowest rate. In a further test, γ BHC alone was compared with γ BHC to which the acetone extract from 10 g. flour was added. Mortality in two hours rose from 94 per cent. for 0·16 μg. γ BHC alone per sq. cm. to 100 per cent. for 0·78–3·1 μg., as compared with 0, 14, 49 and 97 per cent. for 0·16, 0·31, 0·78 and 3·1 μg. γ BHC with flour extract, and the LD50's were 0·1 and 0·78 μg. per sq. cm., respectively. To determine whether the effect of the lipid was indirect, acting through a modification of the structure of the film deposited on filter paper, a comparative test was carried out on glass. The mortality percentages in two hours rose irregularly from 2 to 100 as the deposit of γ BHC alone was increased from 0·006 to 0·03 μg. per sq. cm., and were 0 and 2 for 0·006–0·02 and 0·03 μg., respectively, when groundnut oil was added at 15–45 μg. per sq. cm.

The effect of lipids was also tested by confining batches of 50 adults of *Calandra granaria* (L.) in flasks with 100 g. wheat grains treated with 200 mg. talc or groundnut oil containing various concentrations of γ BHC. The corrected mortality percentages after a week were 0, 2·4, 75·5 and 94·3 for γ BHC at 0·1, 0·2, 1 and 2 μg. per g. wheat in talc, and 2·1, 1·4, 6·9 and 79 for the same quantities with the oil; the LD50 was 4–5 times as high for the oil treatment as for the dust.

It is concluded that the presence of vegetable oils greatly reduces the accuracy of bioassay.

Schvester (D.). **Méthode rapide de détection dans les haricots grains des infestations de bruche** (*Acanthoscelides obsoletus* **Say**).—*Phytiat.-Phytopharm.* **5** no. 1 pp. 53–54, 1 ref. Paris, 1956.

The entrance holes made by the newly hatched larvae of *Acanthoscelides obtectus* (Say) (*obsoletus*, auct.) can be seen on beans of dark varieties, but not on white ones, and staining of the latter by means of iodine is not very satisfactory. Frankenfeld's staining technique [*cf. R.A.E.*, A **41** 178] gives much better results, and is briefly described.

Swaine (G.). **The Maize and Sorghum Stalkborer,** *Busseola fusca* **(Fuller), in Peasant Agriculture in Tanganyika Territory.**—*Bull. ent. Res.* **48** pt. 4 pp. 711–722, 1 map, 9 refs. London, 1957.

The following is based almost entirely on the author's summary. *Busseola fusca* (Fuller) is a serious pest of maize and sorghum in Tanganyika

[*cf. R.A.E.*, A **44** 69], where it occurs mainly at altitudes of 4,000 ft. and over. Its distribution appears to be limited by high temperatures, since fertilised females reared under the relatively hot conditions of Morogoro (1,900 ft.), frequently produced non-viable eggs. In the laboratory, the egg, larval and pupal stages lasted 6–9, 24–36 and 12–16 days, respectively, at 26·4°C. [79·52°F.], and oviposition occurred 2–4 days after the emergence of the females. A larval diapause is induced by the drying out of the food material and was terminated in experiments by bringing the larvae into contact with water.

Field observations in the Western Province in 1954–55 indicated that the first sowings, made within two to three weeks of the beginning of the rains in November or early December, are likely to be heavily attacked by larvae of the first generation. These result from a " rain-induced " flight of adults derived from diapause larvae in the maize and sorghum left in the fields from the previous season, the larvae being induced to pupate when the stems are wetted by rain. There are two generations during the main crop season, from November until June or July, and a third occurs in sorghum tillers produced subsequently. No alternative food-plants of importance were found.

Cultural control by burning the crop residues left in the field after harvest, in order to destroy the diapause larvae [*cf.* **44** 70], is not practicable, as they are required by the peasants for palisading, building contour banks and grazing cattle and goats during the dry season, but the first-generation larvae in young maize can be controlled by applying a dust containing 2·5 per cent. DDT into the funnels of the plants [*cf.* **37** 229]. In 13 experiments on peasant-owned plots in the Southern Highlands Province, in which the dust was applied at 10 lb. per acre four times at weekly intervals, beginning about 18 days after germination, the average weight of maize cobs from 100 plants was increased from about 27·5 to about 50 lb., an increase of some 83 per cent. Factors other than *Busseola* that affect the yield are discussed, and it is suggested that control measures would probably be justified only where a combination of a suitably fertile soil, early planting and adequately distributed rainfall obtains.

MELVILLE (C.). **Quantitative Studies on Tyroglyphid Mite Populations. I. The Determination and Significance of the Egg Density.**—*Bull. ent. Res.* **48** pt. 4 pp. 723–731, 4 graphs, 10 refs. London, 1957.

The quantitative study of Tyroglyphid mites involves their separation from the food material, and existing methods for use with flour are not entirely satisfactory. A new method was developed, depending on chemical treatment to remove the bulk of the flour, and it was rendered quantitative and independent of variations in moisture content by the use of the *Lycopodium*-spore technique. Spores of *L. clavatum*, which are non-hygroscopic, resistant to chemical treatment and very uniform in size and weight, 1 mg. containing a mean of 94,000, are mixed with the culture medium in a known proportion (0·1 per cent. by weight), and the flour is subsequently separated from the mite population by boiling the sample with dilute hydrochloric acid to hydrolyse the starch to soluble sugars and dissolve part of the cereal protein, adding dilute potassium hydroxide until the protein remaining in suspension is dissolved, and centrifuging twice, the second time after treatment with a clearing agent. Mounts are prepared from the residue after the addition of a suspending fluid and the spores and the mites or their eggs, neither of which are visibly affected by the treatment, are counted under the microscope. The weight of medium containing the population is calculated from the number of spores present.

Egg counts provide a useful basis for population studies, and by using the method for the determination of the numbers of hatched and unhatched eggs per unit weight of flour, information on the rate of increase or decrease in the number of hatched eggs (natality rate per unit time), and hence on the ability of the species to survive in a particular environment, can be obtained. In studies with *Tyroglyphus farinae* (Deg.), the eggs were found to be unevenly distributed in the culture medium, and each culture was subsequently divided at the outset between several specimen tubes, the whole contents of each of which could ultimately be used as a sample. Mathematical consideration indicated that the error involved in the technique was associated mainly with the counting of the eggs.

The use of the method is illustrated by work with *Thyreophagus entomophagus* (Lab.). At 65 per cent. relative humidity, no eggs were laid at 30°C. [86°F.], though those present hatched slowly over a period of about nine days, but at 25°C. [77°F.], oviposition and hatching took place during the first 12 days and the natality rate was higher than at 30°C. At 70 per cent. relative humidity and 30°C., oviposition continued throughout the experimental period (21 days); the natality rate was low during the first half and increased rapidly between the 12th and the 18th day, after which hatching practically ceased. At 25°C., and at both temperatures when the relative humidity was 75 per cent., hatching continued throughout the experiment, but overcrowding caused a decrease in oviposition, especially at 25°C., towards the end of it. Both the natality rate and the number of eggs that hatched were greatest at 75 per cent. relative humidity and 25°C. and lowest at 75 per cent. relative humidity and 30°C.

Gratwick (M.). **The Contamination of Insects of different Species exposed to Dust Deposits.**—*Bull. ent. Res.* **48** pt. 4 pp. 741–753, 4 figs., 7 refs. London, 1957.

The following is virtually the author's summary. The quantities of lipophilic dyestuff picked up by adults of *Vespula vulgaris* (L.), *Feronia madida* (F.), *Rhagonycha fulva* (Scop.), *Dysdercus fasciatus* Sign. and *Notostira erratica* (L.) in their first few steps on a dust deposit of the dyestuff were estimated. The uptakes per step by insects of different size and structure differed only slightly. While the uptake was greater for the larger insects, the smaller insects picked up more particles per unit body weight at each step. The ratios of the actual amounts (estimated colorimetrically) picked up by the different pairs of legs were similar for all the insects studied and in all cases the hind legs picked up an amount at least equal to the sum picked up by the fore and middle legs.

The distribution of particles picked up by the tarsi of the five species was determined by counting, under a microscope, all the particles on representative parts of the tarsal segments. The results, together with those for *Phormia terraenovae* R.-D. determined from data published by Lewis & Hughes [*R.A.E.*, B **46** 27] are given. The first segments of the hind tarsi of four of these species picked up considerably more than any of the other tarsal segments. The pretarsi of all legs accumulated only a small percentage of the total uptake. The hind tarsi as a whole were more important accumulators of particles than the fore or the middle tarsi. The efficiency with which each segment collects particles was measured as the percentage uptake per unit length. From a discussion of the differences in these efficiencies it is concluded that the collecting efficiency of a segment is partly a function of the thrust applied to the substrate and, therefore, that measurements of the uptake of particles should provide information concerning the method of use of the tarsal segments in walking. From observations on the

position of particles picked up by the tarsal segments, it is concluded that the tarsal setae help to keep particles away from the main surface of the cuticle, which is not easily contaminated where the setae are dense.

Investigations of the effect of redistribution and loss of particles on an insect that performs vigorous cleaning actions showed that particles are lost from head, thorax and abdomen in the proportions in which they are acquired and that cleaning movements transfer particles in constant proportions from one region to another. The proportions of particles on the three pairs of legs also remain constant but the distribution on the tarsal segments changes.

The influence of structure and behaviour on the contamination of different insects is discussed. It is concluded that an insecticidal treatment is likely to be less effective on insects possessing tarsi that are densely clothed with setae than on those with fewer tarsal setae and more effective on insects that clean themselves frequently than on those that do so rarely. The effect of cleaning by insects that are densely clothed with setae may counteract any protection afforded by these setae.

Howe (R. W.) & Lefkovitch (L. P.). **The Distribution of the Storage Species of *Cryptolestes* (Col., Cucujidae).**—*Bull. ent. Res.* **48** pt. 4 pp. 795–809, 2 figs., 42 refs. London, 1957.

The following is virtually the authors' summary. The present world distribution of six species of *Cryptolestes* found in stored produce is delineated from the evidence of specimens collected from a small number of countries and from specimens collected from produce examined in ships at British ports. It is concluded that *C. ferrugineus* (Steph.) is worldwide, being found in temperate and tropical areas and in humid and dry zones. The range of *C. minutus* (Ol.) is limited by low temperature and low humidity, but it is more abundant than *C. ferrugineus* in the wet tropics. *C. pusilloides* (Steel & Howe) is at present confined to the southern hemisphere but may be spreading slowly. It seems unlikely that this species entered stored products handled by the shipping trade much before 1944 [*cf. R.A.E.*, A **40** 362]. *C. turcicus* (Grouv.) has been identified from Europe, northern and tropical Africa, Turkey, the United States, Uruguay and Argentina, and *C. spartii* (Curt.) only from Europe, North Africa and Turkey. *C. ugandae* Steel & Howe [*cf.* **44** 340; **45** 468] is rare, being found only from Uganda, Nigeria and Ghana.

The type of premises in which each species was found is shown for specimens collected in Great Britain. *C. ferrugineus* and *C. minutus* are principally found in warehouses and other storage premises, especially on stored cereals and groundnuts. *C. pusilloides* also is principally found in warehouses on stored cereals, but shows little sign of becoming an established breeding species. *C. ferrugineus* is found about 2½ times as often as *C. minutus* and about seven times as often as *C. pusilloides*. On farms and in maltings, *C. ferrugineus* is practically the only species found. *C. turcicus* and *C. spartii* are found mainly in flour mills and other kinds of mill, chiefly in the machinery. In other countries also, wherever the two last-mentioned species have been found, they occupy this same habitat except that, in the United States, *C. turcicus* infests stored grain.

Bardner (R.) & Kenten (J.). **Notes on the Laboratory Rearing and Biology of the Wheat Bulb Fly, *Leptohylemyia coarctata* (Fall.).**—*Bull. ent. Res.* **48** pt. 4 pp. 821–831, 3 figs., 9 refs. London, 1957.

The following is largely the authors' summary. An account is given of a method of rearing all stages of *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.)

in the laboratory that was developed in order to provide suitable material, in particular eggs and larvae, for insecticide experiments. A container made from a hurricane-lamp glass was found suitable for the ovipositing adults. Several diets for the adults were compared, and it was found that most eggs were laid when the flies were fed on beef blood and a mixture of sweetened condensed milk and honey. Females were found to lay up to 244 eggs each; egg-laying began 9–15 days after emergence and continued almost as long as the females lived, but reached a peak 3–5 weeks after emergence. Some females survived from late June until early November. In a small laboratory population, the average number of eggs laid per female was 29·9, and the mean length of life was 26·3 days for males and 41·6 days for females. The eggs undergo an obligatory diapause of at least 100 days, which is broken by prolonged exposure to temperatures below 12°C. [53·6°F.], although preliminary exposure to high temperatures is necessary to enable initial morphological development to be completed. The eggs have no effective water-proofing mechanism, but can recover from considerable temporary desiccation. During diapause, they were stored between pieces of nylon in soil in glass tubes or petri dishes that were buried in potting compost in a large flower-pot kept out of doors. The eggs normally hatch in late January or early February, but hatching can be delayed until much later by storage below 0°C. [32°F.]. The effects of temperature on larval and pupal development are described. The larvae developed at 20°C. [68°F.], but exposure to 15°C. [59°F.] or below during the late larval and early pupal stages was essential for oviposition by the resultant females. By a combination of delayed hatching and accelerated larval and pupal development, fertile flies can be obtained at unusual times of the year, and this may make it possible to produce young larvae in autumn for insecticide experiments. Notes are given on the natural enemies observed in various parts of England; they included an Ichneumonid parasite, *Phygadeuon oppositus* Thoms., which was reared from the pupae, and a fungus, *Empusa muscae*, which frequently infested the adults.

McKinlay (K. S.) & Geering (Q. A.). **Studies of Crop Loss following Insect Attack on Cotton in East Africa. I. Experiments in Uganda and Tanganyika.**—*Bull. ent. Res.* **48** pt. 4 pp. 833–849, 6 figs., 19 refs. London, 1957.

Coaker (T. H.). **II. Further Experiments in Uganda.**—*T. c.* pp. 851–866, 4 figs., 13 refs.

The following is based almost entirely on the authors' summary of the first of these papers. The loss of crop following insect attack on cotton was studied in 1950–54 in the elephant-grass zone of Uganda, in which the principal pest of cotton was formerly considered to be *Lygus vosseleri* Popp. In 1953, the main invasion of cotton by *Lygus* occurred during September and October, originating from cultivated crops of *Phaseolus mungo* and sorghum and from the wild leguminous perennial, *Pseudarthria* sp. Trials in this zone had shown over a number of years that early June is the optimum date for sowing cotton, although such sowings receive the heaviest attack by *L. vosseleri*. Bollworms, notably *Heliothis armigera* (Hb.) and *Earias* spp., are also important pests, their attacks following those of *Lygus* and being heaviest in October–November; work in 1952 indicated that a comparatively light attack could cause a greater reduction in yield than an earlier and apparently heavy attack by *Lygus*.

In order to evaluate the effects of these two principal types of pest, parts of single rows of cotton among untreated rows were sprayed weekly with

0·2 per cent. DDT over different periods in 1953–54 to provide protection against *Lygus* or bollworms or both. The sprays were applied during August–September, October–November and August–November on cotton sown on 9th June, and during the last half of September and October, November and the first part of December, and September–November on cotton sown on 10th August, and the experiment was replicated in three parts of an experimental area. Similar tests were also made with more restricted periods of protection. Yields were recorded and crop development was observed throughout the season on each single-row plot. On the early-sown cotton, protection from insect attack for four months did not increase the yield, but caused the crop to form earlier [*cf. R.A.E.*, A **40** 355; **42** 89]. On late-sown cotton, protection was accompanied by an increase in yield in all localities [*cf.* **42** 89], although maximum protection did not necessarily give the greatest increase. It thus appears that where a sufficiently long growing season can be achieved by early sowing, the plant can replace a considerable loss of flower buds and bolls by subsequent growth, so that the total yield may be unaffected.

To investigate the situation in an area with a single rainy season, a shorter growing period and more intense insect attack, two experiments were conducted in 1954 in eastern Tanganyika, where infestation by *H. armigera* is usually severe. In the first, cotton was sown early (31st January) and completely protected from insects by a weekly spray of 0·2 per cent. toxaphene. Insect damage was then simulated by removing flower buds for periods of 4–12 weeks. Owing to a high experimental error, yield differences were not statistically significant, but plants that had been disbudded for 12 weeks eventually yielded almost the same amount of cotton, although in a much shorter period, as those not disbudded at all. The second experiment was on the control of *H. armigera* by insecticides applied to cotton sown late (23rd March). All treatments gave highly significant increases in yield, the best being a dust containing 10 per cent. DDT with 3 per cent. γ BHC and an emulsion spray containing 0·8 per cent. DDT with 0·25 per cent. γ BHC, for which the yields were 968 and 973 lb. seed cotton per acre, respectively, as compared with 211 lb. from the control plots and 834 and 777 lb. from plots dusted with 20 per cent. toxaphene and 10 per cent. DDT with 10 per cent. toxaphene, respectively. It thus appeared that, even under the prevailing local conditions, cotton can recover from considerable loss of fruiting bodies, provided that it is sown sufficiently early, although late-sown cotton has even less chance of recovery from such damage than it has in Uganda.

It is concluded that the cotton plant has remarkable powers of recovery from insect damage and that the application of insecticides will increase yields only when damage exceeds the point at which recovery is still possible. Any factors tending to shorten the growing season or any increase in the severity of insect attack will reduce the power of recovery and make the need for insecticidal control more likely, but it is evident that the presence of insects feeding on the plant does not always render such control necessary or profitable [*cf.* **45** 168].

The following is almost entirely the author's summary of the second paper. The study of crop loss following insect attack on cotton in Uganda was continued for two further seasons (1954–56) using the same experimental procedure, except that half the DDT in the spray formulation was replaced by toxaphene, the three periods of protective treatment for each date of sowing were not varied, and the late-season ones were continued until boll-opening was complete, so as to give maximum control of bollworms. Methods are described for estimating an index of leaf damage caused by *Lygus* spp., based on comparison with standard grades. In the Eastern Province, the index of leaf damage was closely related to *Lygus* populations

in the crop, and in Buganda it was markedly reduced on plots protected from *Lygus* attack, but no relation could be found in 1954–56 between the mean seasonal index and the loss of fruiting bodies attributable to *Lygus* attack or the final yield. Analysis of the cause and incidence of the shedding of flower buds or young bolls, of which the latter predominated among those recovered, showed that the total amount was about the same whatever the treatment, shedding caused by insect damage tending to be balanced by that due to other causes, which were probably physiological in nature. There was thus some overriding factor, other than pest attack, that governed the crop finally held by the plant. Damage caused by insects to older bolls, which are not shed, constitutes a real loss that is reflected in the final harvest. The proportion of clean seed cotton was higher in the treated plots, particularly in the early-sown cotton, in which analysis of the harvested locules showed that the damage was predominantly due to bollworms, but there were no significant differences in yield between the various treatments in either date of sowing or in either season. It is concluded that, under the conditions experienced during the three seasons of the experiments, insect damage to cotton is small in relation to other environmental factors governing crop production.

Schmitz (G.). **L'acariose du cotonnier.**—*Bull. INEAC* **5** no. 5 pp. 329–339, 1 col. pl., 5 figs. Brussels, 1956.

Hemitarsonemus latus (Banks) is an important pest of cotton in the north of the Belgian Congo. All stages of this mite, its bionomics and the damage that it causes to the plants are described [*cf. R.A.E.*, A **31** 297], and it is stated that infestation first appears about a month after sowing, though damage to the leaves is seldom visible before the end of a further 4–6 weeks. Cotton production is reduced by 30–35 per cent. under these conditions, but by up to 70 per cent. if attack is early. The degree of infestation fluctuates from year to year and also differs with the variety of cotton. It is higher in small isolated plots, especially in forest areas, than in open fields, and in districts with a regular and moderate rainfall, as shade and a high relative humidity favour the development of the mite, and it is reduced by heavy rains when the cotton plants are young and liable to be splashed by mud, and by the dry season. The grouping together of fields, the clearing of trees, and spacing of the plants are therefore recommended. In tests of toxicants, sprays affording 11·25 lb. wettable sulphur, 4·5 lb. technical DDT or toxaphene or 0·45 lb. parathion per acre, applied in early September and early October, prevented infestation, as compared with 15 per cent. plants attacked for no treatment. On an isolated plot, a dust of 2 per cent. parathion applied on the same dates at 22·5 lb. per acre also gave good protection. In tests on control, a dust of 10 per cent. toxaphene and 5 per cent. DDT at 18 lb. per acre applied twice in late September with an interval of three days reduced the percentage of infested plants from 17 to 0·4, but a dust of 2 per cent. parathion applied at the same rate four times in 19 days reduced it only from 2·5 to 1·7.

Kenaga (E. E.). **An Evaluation of the Use of Sulfur Dioxide in Fumigant Mixtures for Grain Treatment.**—*J. econ. Ent.* **49** no. 6 pp. 723–729, 3 figs., 5 refs. Menasha, Wis., 1956.

The following is based on the author's summary. The value of sulphur dioxide in mixtures for the fumigation of grain was studied under laboratory

conditions. Tests with larvae of *Attagenus megatoma* (F.) (*piceus* (Ol.)) and adults of *Tribolium confusum* Duv. and analyses of the interstitial air by thermal conductivity and mass spectrometry indicated that sulphur dioxide was highly sorbed by grain, or reacted with it, and did not penetrate into it appreciably when applied to the surface in an essentially leak-proof chamber. Small-scale tests showed that sulphur dioxide was toxic to various stages of *A. megatoma*, *T. confusum* and *Calandra* (*Sitophilus*) *granaria* (L.), and its use in fumigant mixtures might enhance the kill of insects on the surface areas of grain immediately after application, but it had no appreciable residual effect. It did not eliminate musty odour in grain, except possibly temporarily, or lower the moisture content or temperature. With inflammable grain fumigants it reduced the danger of fire at the time of application, but it had no value in reducing the inflammability of carbon bisulphide, which penetrates through most of the grain.

Fukuto (T. R.), Metcalf (R. L.), March (R. B.) & Maxon (M.). **A water soluble systemic Insecticide O,O-Diethyl S-2-Ethylmercaptoethyl Phosphorothiolate Methosulfate.**—*J. Amer. chem. Soc.* **77** no. 13 pp. 3670–3671, 3 refs. Easton, Pa., 1955.

Metcalf (R. L.), Fukuto (T. R.), March (R. B.) & Stafford (E. M.). **The systemic Behavior of Systox Thiol Isomer Sulfoxide and Methosulfate in Plants.**—*J. econ. Ent.* **49** no. 6 pp. 738–741, 3 figs., 5 refs. Menasha, Wis., 1956.

In the first of these papers, the authors describe the preparation of O,O-diethyl S-2-(ethylthio)ethyl phosphorothioate methosulphate from O,O-diethyl S-2-(ethylthio)ethyl phosphorothioate (demeton-S) and report that it was about 100 times as effective as the latter in inhibiting fly-brain cholinesterase. It was extremely soluble in water and showed excellent systemic activity in the cotton plant. When it was applied to the bases of young cotton plants (in the six-leaf stage), at the rate of 5 µl. per plant, and leaves picked after various intervals were tested for contact action on *Heliothrips haemorrhoidalis* (Bch.), *Tetranychus telarius* (L.) (*bimaculatus* Harvey) and *Aphis gossypii* Glov., the mortality percentages in 48 hours were 95, 80, 20 and 5 for the thrips and 90, 70, 90 and 80 for the mite after 1, 2, 3 and 6 weeks, respectively, and 100 for the Aphid after 24 hours and 1–6 weeks. Evaluation of contact toxicity to the house-fly [*Musca domestica* L.], thrips and mosquito larvae gave median lethal concentrations of 0·4, 0·01 and 0·001 per cent., respectively.

The following is based largely on the authors' summary of the second paper. The systemic behaviour of demeton-S and its methosulphate and sulphoxide (O,O-diethyl S-ethyl-2-sulphinylethyl phosphorothioate [*cf. R.A.E.*, A **44** 231]) applied topically to the stems of young cotton plants was studied by means of ^{32}P radiotracers and paper chromatography [*cf.* **45** 181, etc.]. Demeton-S was absorbed and translocated much more rapidly than the sulphoxide for up to seven days after application. At 14 days, the amounts were nearly equal, and at 30 days the sulphoxide was present in appreciably greater amounts. The methosulphate accumulated much more slowly, indicating a lower degree of penetration of this strongly polar compound through the plant cuticle. The rates of metabolism and decomposition of demeton-S and its sulphoxide were approximately the same, and small amounts of the sulphone [*cf.* **45** 181] were formed from both. Radioautography after topical application to young lemon leaves showed that the penetration and spread in the leaf interior was most rapid for demeton-S and least so for its methosulphate, but more rapid for O,O-diethyl O-2-(ethylthio)ethyl phosphorothioate [demeton-O] than for demeton-S sulphoxide.

Snetsinger (R.). **Biology of *Bdella depressa*, a predaceous Mite.**—*J. econ. Ent.* **49** no. 6 pp. 745–746. Menasha, Wis., 1956.

During the spring and autumn of 1955, large populations of *Bdella depressa* Ewing were found overwintering under the bark of trees and in grassy areas near Champaign and Urbana, Illinois. The eggs of this mite were the most abundant, but all stages except the larvae were present. The eggs hatched in early April, and the larvae, nymphs and adults preyed on all stages of the Tetranychids, *Bryobia praetiosa* Koch, *Tetranychus telarius* (L.), *Petrobia latens* (Müller), *P. harti* (Ewing) and *Schizotetranychus* sp., and on two Collembola, *Bourletiella hortensis* (Fitch) and *Willowsia platani* (Nicolet). The stages in the life-cycle of *Bdella depressa* comprise the egg, deutovum, larva, protonymph, deutonymph, tritonymph and adult, the larval and nymphal stages terminating in quiescent periods. In the laboratory at 90 per cent. relative humidity, development from larva to adult lasted 21–30 days at 60°F. and 14–21 days at 70° when *Bryobia praetiosa* and *T. telarius* were provided as food. Attempts to rear the Bdellid at higher or lower temperatures failed, though some development occurred at 47 and 85°F. *Bdella depressa* appears to be an important predator of *Bryobia* in grassy areas; this is probably because their life-cycles are similar, both being abundant only in spring and autumn, apparently owing to summer diapause, both requiring humid cool conditions, and both overwintering mainly as eggs in similar habitats and hatching at much the same time in spring. It appears to be less important as a predator of *T. telarius*, which requires other conditions.

Floyd (E. H.) & Newsom (L. D.). **Protection of Stored Corn with Lindane-impregnated Sawdust.**—*J. econ. Ent.* **49** no. 6 pp. 753–757, 1 ref. Menasha, Wis., 1956.

An account is given of further experiments in Louisiana [*cf. R.A.E.*, A **42** 151] in which pine sawdust impregnated with 5 per cent. γ BHC as lindane was tested for the protection of stored maize from insect attack. The results showed that dosages of γ BHC as low as one part per million of the commodity protected snapped maize, which was attacked mainly by *Calandra* (*Sitophilus*) *oryzae* (L.), for 12 months; dosages up to 4 p.p.m. failed to protect husked maize, which was infested mainly by *Sitotroga cerealella* (Ol.), whereas 10 p.p.m. gave complete protection, γ BHC being apparently many times more toxic to the weevil than to the moth. Tightness of construction of the bin appeared to be desirable, though not essential for control. Shelled maize, lightly infested with both species, remained in perfect condition for 13 months when treated at 0·5 p.p.m. in one test, but not in another; treatment with 0·1 p.p.m. was very effective for ten months. Grain treated with 10 p.p.m. γ BHC for three months and then freed from the sawdust was either toxic or repellent to *C. oryzae* for another 12 months.

The immature stages of both insects in shelled maize were adversely affected by γ BHC at 10 p.p.m. but not at 5 p.p.m. or less. Equivalent amounts of γ BHC from the sawdust or as a 1 per cent. dust were equally effective in protecting shelled maize, and 7 p.p.m. DDT from a 5 per cent. dust was as effective as 4 p.p.m. γ BHC.

In practical tests with the sawdust in cribs of the open type normally found in Louisiana, maize ears or shelled maize treated with 10 p.p.m. γ BHC remained in essentially the same condition for 12 months, but the treatment is not recommended as there is no official tolerance for γ BHC on grain and the magnitude of the residues is not known.

Concomitant observations indicated that *Tribolium confusum* Duv. is little affected by the impregnated sawdust.

Mistric jr. (W. J.) & Martin (D. F.). **Effect of Sunlight and other Factors on the Toxicity of certain Insecticides.**—*J. econ. Ent.* **49** no. 6 pp. 757–760, 6 refs. Menasha, Wis., 1956.

Investigations were carried out at College Station, Texas, in 1954 on the effects of climatic and other factors on the toxicity of certain insecticides to adults of *Anthonomus grandis* Boh. and larvae of *Alabama argillacea* (Hb.) on cotton. Calcium arsenate was applied as a dust, and all other toxicants in emulsion sprays at the rate of 5 U.S. gals. per acre, and the treated plants were infested with field-collected insects.

After exposure of the treated plants for 24 hours to 0·87 inch natural rain, BHC, heptachlor and aldrin, applied at 0·33 lb. per acre, were completely ineffective against *Anthonomus*, whereas 2 lb. toxaphene and 0·33 lb. dieldrin still gave appreciable control. Similar exposure to high temperature outdoors under shade practically eliminated the insecticidal effect of the first three, and there was little additional loss on exposure in sunlight, but toxaphene and dieldrin retained considerable toxicity at high temperatures in either sunlight or shade, the former being equally effective under the two conditions, and the latter less so in sunshine.

Increasing the dosages of toxaphene, BHC, heptachlor and endrin from 2, 0·33, 0·36 and 0·12 to 3, 0·45, 0·54 and 0·18 lb. per acre, respectively, slightly increased the initial control of *Anthonomus* on treated plants, but not enough to justify the use of the higher rates. When plants treated with the four insecticides at either dosage were exposed to outdoor weather conditions, BHC and heptachlor were virtually ineffective after 48 hours, whereas endrin retained slight and toxaphene considerable toxicity. Repeated outdoor applications of 2·67 lb. toxaphene or 0·37 lb. BHC per acre at five-day intervals did not increase the control of weevils put on the plants immediately or 48 hours after the last treatment. The application of 3 lb. toxaphene, 3 lb. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.], 0·23 lb. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] and 0·12 lb. Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] per acre, respectively, resulted in 54, 48, 92 and 87 per cent. control of *Anthonomus* immediately, 41, 36, 57 and 83 per cent. after exposure of the plants for 24 hours indoors, and 25, 32, 38 and 82 per cent. after exposure for 24 hours outdoors under conditions of heavy dew and some wind.

The effectiveness of 0·04 lb. parathion or 0·09 lb. endrin per acre in controlling *Alabama* was reduced to a greater extent than that of 0·88 lb. toxaphene or 6·75 lb. calcium arsenate during a 24-hour exposure of treated plants outdoors in the absence of rain, but all showed good residual properties under these conditions. Simulated rain (0·5 inch) was slightly more detrimental when applied immediately after treatment than 24 hours later; it reduced the toxicity of toxaphene and parathion slightly, that of endrin appreciably and that of calcium arsenate very greatly.

Mistric jr. (W. J.) & Martin (D. F.). **Effect of climatic Conditions on the chemical Control of certain sucking Pests of Cotton.**—*J. econ. Ent.* **49** no. 6 pp. 760–763, 3 refs. Menasha, Wis., 1956.

Investigations were carried out at College Station, Texas, in 1954 on the effect of weather conditions on the toxicity of parathion and Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] to *Tetranychus desertorum* Banks and *T. telarius* (L.) and of parathion and BHC to *Aphis gossypii* Glov. placed on cotton seedlings treated with emulsion sprays applied at 7·5 U.S. gals. per acre. The results showed that the Aphid was

more effectively controlled with 0·25 lb. parathion or 1·2 lb. BHC per acre at a temperature of 94°F. than at 70 or 107°F. BHC was ineffective one day after application at all three temperatures, but parathion showed appreciable residual toxicity for three days at the two higher ones. In another test under similar conditions, parathion gave about the same results, but BHC proved more effective, indicating the difficulty of predicting the climatic conditions under which BHC would be most toxic. The persistent effect of parathion was about as great against the mites as against the Aphid, but that of Aramite decreased considerably after a day, especially against *T. desertorum*. Exposure to dew, rain, wind, high temperature or sunlight somewhat reduced the effectiveness of the parathion deposits, but generally had much less effect on those of BHC or Aramite, though they tended to accelerate the loss of toxicity.

Lloyd (E. P.) & Martin (D. F.). **Control of the Brown Cotton Leafworm, *Acontia dacia* Druce.**—*J. econ. Ent.* **49** no. 6 pp. 764–766, 1 graph, 5 refs. Menasha, Wis., 1956.

Heavy infestation by *Acontia dacia* Druce developed on cotton in Texas early in 1955 [*cf. R.A.E.*, A **43** 431]. In tests on its control, cotton plants were treated with emulsion sprays in the laboratory, and infested with fourth-instar larvae. Mortality was recorded daily, and the median lethal dosages in lb. per acre, determined from the curves for mortality after five days, were about 0·0025 for parathion, 0·0057 for Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate], 0·0198 for endrin, 0·0283 for malathion, 0·0627 for Hercules AC-528 (2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)), 0·0583 for diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 0·112 for Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], 0·3372 for toxaphene and 0·3724 for Pyrazoxon [diethyl 3-methyl-5-pyrazolyl phosphate].

In field tests in which sprays were applied at 2·5 U.S. gals. per acre to infested seedling cotton in April or May, 0·0625 and 0·125 lb. parathion, 0·1 and 0·2 lb. malathion and 0·1 lb. endrin per acre significantly reduced the numbers of larvae present after three days, with no significant difference between them, but aldrin, toxaphene, diazinon, γ BHC and heptachlor at 0·125, 0·75, 0·125, 0·15 and 0·125 lb. per acre, respectively, did not; there was no significant difference between treated and untreated cotton nine days after application. When sprays were applied at 7·5 U.S. gals. per acre on 31st August to mature cotton that was heavily infested by larvae and on which adults in large numbers were still ovipositing, causing reinfestation of all plants after treatment, 2·5 lb. toxaphene, 0·25 lb. malathion, 0·2 lb. endrin, 0·0625 lb. parathion, 0·5 lb. Chlorthion, 0·1 lb. Bayer 17147 and 0·3 lb. Hercules AC-528 per acre all gave effective control for six days, with no significant difference between them, and all but malathion significantly reduced the numbers of small larvae that hatched by the ninth day.

Kantack (E. J.) & Floyd (E. H.). **Control of some Insects which damage Roots of Sweet Potatoes in the Field.**—*J. econ. Ent.* **49** no. 6 pp. 766–768, 1 fig., 1 ref. Menasha, Wis., 1956.

Tests on the value of soil insecticides for the control of insects attacking sweet-potato tubers in the field in Louisiana were continued in 1955 [*cf. R.A.E.*, A **45** 12], when larvae of *Lachnosterna* (*Phyllophaga*) spp., *Diabrotica balteata* Lec. and flea-beetles, mainly *Chaetocnema confinis* Crotch, appeared to be the most injurious pests present. Aldrin and heptachlor were applied as granules in bands 6–8 ins. wide and also in a wettable powder and emulsion concentrate, respectively, mixed with fertiliser and

distributed along 2-inch bands, during the preparation of the soil, so that the granules were distributed in the top four inches of soil and the fertiliser mixtures placed 4–6 ins. below the surface; the powder and concentrate were also applied in 27 U.S. gals. water per acre, as a spray applied to bands 12–16 ins. wide, and worked into the soil. The insecticides were used in all cases at 1·7 and 2 lb. per acre, and all treatments gave good protection, with no significant differences between them, when the percentage injury in untreated soil was 6·8 or 40·8. When it was 98, the two insecticides still gave significant protection at 2 lb. per acre (the only rate tested), but the sprays appeared to be slightly though not significantly better than the granules, and both were much better than the fertiliser mixtures. Treatment of the plants with 2 lb. aldrin or dieldrin per acre in the starter water, with or without fertiliser, gave good control and also reduced damage by *Cylas formicarius elegantulus* (Summers) where this weevil was present. None of the treatments adversely affected plant growth.

Observations on the residual effect of aldrin and chlordane, applied along the row at 3 lb. per acre in granules in 1953 [**45** 13], showed that both protected the tubers from insects other than the weevil in 1954, but not in 1955, aldrin being slightly superior to chlordane; neither had any residual effect on *Cylas*.

Wilcox (J.) & Howland (A. F.). **Experiments on Control of the Tomato Russet Mite in southern California.**—*J. econ. Ent.* **49** no. 6 pp. 768–771, 2 refs. Menasha, Wis., 1956.

The following is based on the authors' summary of this paper in which the results are given of experiments carried out in southern California between 1942 and 1955 on the control of *Vasates lycopersici* (Massee) on tomato [*cf. R.A.E.*, A **43** 416, etc.]. Excellent control was obtained by including 25 per cent. sulphur in dusts directed against the tomato fruitworm [*Heliothis zea* (Boddie)] and by applying dusts of 25, 50, 75 or 100 per cent. sulphur, which differed little in effectiveness, three times at intervals of two weeks, beginning when 5–10 fruits had set per plant, but inferior results were given by 1–2 applications only. In three dust applications, 20 per cent. toxaphene, 5 per cent. chlordane, 2·5 per cent. dieldrin and a mixture of 2 per cent. EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] and 5 per cent. DDT were very effective, and 2 per cent. parathion with 5 per cent. DDT, 2·5 per cent. methyl-parathion, and 2 per cent. isodrin were effective in limited tests, but 10 per cent. DDT, 2·5 per cent. aldrin, 5 per cent. heptachlor, 5 per cent. γ BHC, and 1·5 per cent. of the dicyclohexylamine salt of dinex gave poor results. Suspension sprays of 3 lb. toxaphene or chlordane, 1·5 lb. dieldrin, 0·5 lb. EPN or 4 lb. schradan per 40 U.S. gals. gave excellent results when applied three times at 26–36 U.S. gals. per acre, and a single application of toxaphene in an emulsion spray controlled a light infestation of *V. lycopersici* when substituted for DDT in one of the three regular applications against *H. zea*.

On plants grown during cool weather, as in late autumn or early spring, sulphur was not always effective; toxaphene, EPN, parathion and methyl-parathion gave satisfactory control under these conditions and can be used alone or combined with the DDT used against *H. zea*.

Shands (W. A.), Simpson (G. W.) & Dudley jr. (J. E.). **Low-elevation Movement of some Species of Aphids.**—*J. econ. Ent.* **49** no. 6 pp. 771–776, 3 figs., 21 refs. Menasha, Wis., 1956.

In connection with studies on the importance of low-elevation flight of alates in the spread of *Macrosiphum pisum* (Harris) on peas in Wisconsin

and New York and of species that transmit viruses to potatoes in Maine, catches of Aphids were made by means of adhesive screens in the first two States in 1923–28 and windvane traps in Maine in 1942–44. The following is based on the authors' summary of the results. Catches of *M. pisum* tended to be greatest at a height of 17 ft. within the 29·5 ft. sampled in Wisconsin and at 3–8 ft. in the 10·5 ft. sampled in New York, and within the vertical 30-ft. trapping range used in Maine, catches of *Aphis abbreviata* Patch, *Myzus persicae* (Sulz.) and *Macrosiphum solanifolii* (Ashm.) were highest at 10–20, 10–25 and 15–25 ft., respectively. Sharply reduced catches near the tops of the screens were probably due to wind currents, and more gradual reductions near the bottoms to wind eddies round the screens and to impediments to flight in the form of vegetation. The results suggest that short distances between fields will give little protection against the spread of infestation.

Smith (E. H.) & Wagenknecht (A. C.). **The Occurrence of Cholinesterase in Eggs of the Peach Tree Borer and Large Milkweed Bug and its Relationship to the ovicidal Action of Parathion.**—*J. econ. Ent.* **49** no. 6 pp. 777–783, 3 graphs, 17 refs. Menasha, Wis., 1956.

Since it had been postulated from previous work that the toxic effect of parathion on eggs of *Aegeria* (*Sanninoidea*) *exitiosa* Say is due to inhibition of cholinesterase in the later stages of embryonic development [*cf. R.A.E.*, A **45** 22], the occurrence and nature of cholinesterase in the developing eggs and in those of *Oncopeltus fasciatus* (Dall.), which are not susceptible to parathion at normal concentrations, were investigated, together with the inhibitory effect of parathion on these enzymes. *In vitro* studies were carried out on egg breis, and *in vivo* studies by exposing the eggs on impregnated filter papers before the assays were made. At 80°F., the eggs of the two species hatched in 8·5 and 6·1 days, respectively, and it was found that cholinesterase activity began on about the fourth day and increased thereafter until hatching in both, being about three times as great for *A. exitiosa* as for *O. fasciatus* in eggs that were in advanced stages of development. Parathion inhibited cholinesterase activity in eggs of *A. exitiosa*, regardless of whether the activity had begun at the time of application, and this is believed to indicate that ovicidal action is related to cholinesterase inhibition and to demonstrate the retention of the toxicant by treated eggs. The properties of the esterases from the eggs of the two species were found to differ, but the relation of this to parathion susceptibility was not established. Treatment with parathion *in vivo* resulted in 84–85 and 8–15 per cent. inhibition in *A. exitiosa* and *O. fasciatus*, respectively, whereas application *in vitro* caused over 50 per cent. inhibition in both, which suggests that the apparent resistance of the *Oncopeltus* eggs is due to the failure of parathion to reach the site of action. The results confirm the original hypothesis with regard to the eggs of *Aegeria*.

Cowan jr. (C. B.), Parencia jr. (C. R.) & Davis (J. W.). **Late-season Control of the Boll Weevil and the Bollworm with new Insecticides in 1955.**—*J. econ. Ent.* **49** no. 6 pp. 783–785, 1 ref. Menasha, Wis., 1956.

Experiments with insecticides applied as dusts or low-volume sprays for the control of late-season infestation of cotton by *Anthonomus grandis* Boh. and *Heliothis zea* (Boddie) were made in central Texas in 1955. Where the latter insect was present in tests against the former, it was eliminated by DDT, so that it had little, if any, effect on the results; in the tests against

Heliothis, infestation by *Anthonomus* was too low to affect the results appreciably.

In several tests with sprays applied against *Anthonomus* at 6–7·5 U.S. gals. per acre 9–12 times in July–September, Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] gave excellent control and increased the yield at 0·25 and 0·375 lb. per acre; some control was given by 0·125 lb. Bayer 17147, 0·25 lb. Bayer 16259 [O,O-diethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate], 2·7 lb. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] or toxaphene, and 0·68 lb. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], but 0·68 lb. Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] was ineffective. Dieldrin at 0·43 lb. per acre compared favourably in control and yield increase with Bayer 17147 at 0·36 lb. in a large-plot experiment, and DDVP [dimethyl 2,2-dichlorovinyl phosphate], with or without Aroclor (a chlorinated terphenyl), was ineffective at 0·71 lb. per acre in sprays and at 0·41 lb. per acre in dusts applied five times in July.

Sprays or dusts were applied against *H. zea* 3–4 times in July. Bayer 17147 was ineffective in sprays at 0·375 lb. per acre when used alone, though it showed promise when combined with 0·5 lb. DDT; at 0·5 lb. it was less effective in sprays than 0·3 lb. endrin or than 2 lb. toxaphene with 1 lb. DDT and in dusts it was less effective than 0·33 lb. endrin and 7·68 lb. of a mixture of γ BHC, DDT and sulphur (3 : 5 : 40) per acre. In a large-scale spray test, 0·3 lb. endrin and mixtures of 2 lb. toxaphene or Strobane with 1 lb. DDT per acre all gave good control and increased the yield.

Sylvester (E. S.). **Beet Yellows Virus Transmission by the Green Peach Aphid.**—*J. econ. Ent.* **49** no. 6 pp. 789–800, 2 graphs, 31 refs. Menasha, Wis., 1956.

The virus yellows disease of beet, which is of importance in several European countries, also occurs in California [*cf. R.A.E.*, A **42** 261], and since little is known of its transmission there, a detailed study was made of the relations of the virus to the vector Aphid, *Myzus persicae* (Sulz.). The results are compared with those obtained by other workers [*cf.* **29** 65; **35** 204], and the following is based on the author's summary of them. The minimum period of feeding for virus acquisition by the Aphid was one hour, but the optimum period was about 12 hours; transmission was effected in feeding periods of one hour (the shortest tested), and reached its maximum efficiency with periods of about six hours. The longest time for which the virus was retained by Aphids transferred to successive healthy beet plants daily was three days, but serial transfers effected every eight hours showed that it had a half-life in the Aphid of about eight hours. Some of the Aphids used in the latter tests were also infected with the beet yellow-net virus, and transmission of this gradually increased with successive transfers, indicating either that there was a latent period in the vector or that the ability of the latter to transmit this virus was affected by some conditioning factor associated with the test plants or the test feeding. Yellows virus was retained by fasting Aphids for the longest interval tested (24 hours), but the data suggested that it had a half-life of about 2·5 hours in them, the rate of loss of infectivity thus being greater in fasting than in feeding Aphids.

Factorial experiments indicated that the Aphid could carry both viruses at the same time; it did not infect a healthy beet plant with both during any one eight-hour test feeding period when single insects were used, but batches of insects frequently effected double transmission to individual

plants. The failure with single insects was apparently due to the low probability of transmitting the yellow-net virus in these tests rather than to any mechanism within the insect preventing the viruses from being ejected simultaneously. Beet leaves without evident symptoms tended to be better sources of the yellows virus than leaves with them, whereas the converse was true for the yellow-net virus. When transmission was effected from plants infected with both viruses, it was of little consequence whether the symptoms of either disease were present on the leaves used for acquisition feeding. Individual dually infected beet plants varied considerably in their capacity to serve as virus sources, but superiority of a plant as a source of one virus did not ensure that it would be a good source of the other. There were no indications that the acquisition of either virus before the other influenced the ability of the insects to transmit, but if the last acquisition feeding was on a plant infected with the yellow-net virus, there was a loss of yellows infectivity comparable with that due to feeding on a healthy plant.

Experiments to determine the effect of different numbers of infective Aphids on the probability of yellows transmission showed that this was constant, indicating that each infection could be considered as a separate and independent event, when only infective groups were tested. When non-infective Aphids were added to the infective ones, the probability of infection tended to vary, but the change could not be associated with the non-infective members of the test groups.

Comparison of characteristics suggests that the beet yellows virus represents a group of Aphid-borne viruses that appears to be distinct from both the non-persistent and persistent groups, though in some ways similar to both. The term semi-persistent is used for it, and the existence of such a group supports the view that the vector-virus relations of Aphid-borne viruses form a continuous series.

Krantz (G. W.). **A Laboratory Method for testing Grain Protectants against the Grain Mite.**—*J. econ. Ent.* **49** no. 6 pp. 813–814, 1 fig., 1 ref. Menasha, Wis., 1956.

A method was devised for determining the effectiveness of toxic dusts against *Tyroglyphus farinae* (Deg.) (*Acarus siro*, auct.) by measuring the extent to which the mites penetrated treated flour. Mites were introduced into 150-mm. test-tubes containing 52·5 mm. flour, the upper 12·5 mm. of which had been mixed with the protectant at the rate of 7·94 g. per lb. (105 lb. per 1,000 bushels), and prevented from escaping by means of a ring of vaseline above the flour surface. The tubes were kept at about 22°C. [71·6°F.] for 11 days, and the degree of penetration was then determined from the trails left by the mites.

Untreated flour showed a complete pattern of trails throughout its depth. Treatment with Pyrenone Wheat Protectant (1·1 per cent. technical piperonyl butoxide and 0·08 per cent. pyrethrins in wheat dust), ryania or 10 per cent. methoxy-DDT (methoxychlor) resulted in complete patterns either throughout the whole of the flour or throughout the treated flour with some movement into the untreated portion. Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] or 25 per cent. wettable Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] resulted in complete patterns in the treated flour, with penetration into the untreated in some instances only, 25 per cent. malathion or a mixture of 10 per cent. piperonyl butoxide with 1 per cent. pyrethrins in sparse or complete patterns in the treated flour, and Neotran [di(p-chlorophenoxy)methane] and 0·5 per cent. γ BHC as lindane in penetration varying from practically none to

sparse and to complete patterns in the treated flour, respectively, Neotran being significantly better than γ BHC. Examination of the tubes a month after treatment showed further activity only in those in which the mites had penetrated to the untreated flour, which showed some increase in mite trails.

Lilly (J. H.) & Fahey (J. E.). **Translocation of BHC from high-dosage Soil Treatments applied before planting.**—*J. econ. Ent.* **49** no. 6 pp. 815–818, 5 refs. Menasha, Wis., 1956.

In tests in Iowa on the translocation of BHC from treated soil to the seeds of crop plants, γ BHC as lindane was applied as a spray to the soil in plots at 50 lb. per acre in early June 1952 and disked in soon after. Crops were grown on the plots in that and the three following years, and the harvested seed was subjected to chemical analysis and in some cases biological or other tests. The chemical analyses showed the presence of BHC in small amounts in the seeds in all years. Soy beans were the only crop tested in all four, and they contained averages of 0·74, 0·89, 0·27 and 1·21 parts per million, respectively. The results obtained were least consistent for dent maize, which showed no BHC in three samples in 1952 and only slight traces in two of four samples in 1953, whereas small amounts occurred in all four samples in 1955. Sweet maize generally contained small amounts, averaging 0·71 p.p.m. in 1954 and 0·41 and 0·04 p.p.m. in two varieties in 1955. A popcorn variety of maize, grown in 1955, contained no BHC, but beans in 1953 and 1954 and sunflowers and sorghum in 1954 and 1955 consistently showed small amounts.

Other plots in the same field were treated with 10 lb. pure γ BHC or lindane per acre just before sowing in 1955, and the seed from some of the crops grown in them showed small amounts of BHC. Several varieties of maize showed averages ranging from 0 to 0·44 p.p.m., and soy beans contained 0·82–0·97 p.p.m., other beans 0–0·06 p.p.m., and sunflower seeds 0–0·23 p.p.m., but none was found in sorghum seed. Beans grown in 1954 on untreated soil from seed containing 0·13 p.p.m. BHC showed questionable traces of the insecticide.

In view of the excessive rates of application and the minute amounts of insecticide recovered from the various samples, translocation is unlikely to lead to residues anywhere near the official U.S. tolerances of 10 p.p.m. for lindane and 5 p.p.m. for BHC on fruits and vegetables.

A preliminary test in which adults of *Tribolium confusum* Duv. were confined with crushed maize kernels from the various samples taken in 1955 showed no adverse effects on the insects from translocated BHC, and maize and soy beans grown in 1952 on the treated soil were not inferior in germination to control seed. Maize grown for popcorn in 1955 on soil treated in 1952 or 1955 had no abnormal taste or odour, and its popping expansion was not impaired.

Rabb (R. L.) & Guthrie (F. E.). **Tobacco Hornworm Control Experiments in North Carolina, 1953–1955.**—*J. econ. Ent.* **49** no. 6 pp. 818–820, 1 ref. Menasha, Wis., 1956.

The results are given of investigations on the effectiveness of insecticides against *Protoparce sexta* (Joh.) on tobacco in North Carolina. In emulsion sprays applied against larvae, mainly in the fourth or fifth instars, at 35–40 U.S. gals. per acre in 1953, 1 lb. DDD (TDE), 0·2–0·4 lb. endrin and 2 lb. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content

of about 66 per cent.] per acre all gave excellent control, 0·4 lb. endrin acting most rapidly. When applied against larvae in the third, fourth and early fifth instars at about 20–30 lb. per acre in 1954, dusts of 0·75, 1·5 and 2 per cent. endrin all gave satisfactory control, with no difference between them, but the two 2 per cent. dusts were slower in action than the others. This was because they were formulated with active diluents and no deactivator, so that the endrin in them suffered 42–50 per cent. decomposition. A 10 per cent. DDD dust, though slow initially, gave slightly better control than endrin.

In 1955, when both emulsion sprays and dusts were tested against larvae in the third, fourth and fifth instars, 21 lb. 70 per cent. cryolite dust per acre, and DDD at 0·13 lb. per acre in a spray applied to the tops of the plants only, gave little control; the latter would probably be more effective if applied when the fourth-instar larvae begin to appear and practically all are on the top third of the plant. Endrin at 0·3 lb. in 35 U.S. gals. spray per acre was very effective and was significantly better after 24 hours than 0·83 lb. DDD in a spray, but not than 22–24 lb. of a dust containing 10 per cent. DDD or 1·5 per cent. endrin or than a spray of 1·6 lb. toxaphene per acre.

It is concluded that endrin is as satisfactory in properly formulated dusts as in sprays, and that in the latter it is more rapid in action than DDD, Strobane or toxaphene, though all are equally effective after 48 hours.

Eden (W. G.). **Experiments on Earworm Control on Sweet Corn.**—*J. econ. Ent.* **49** no. 6 pp. 822–825, 15 refs. Menasha, Wis., 1956.

The following is substantially the author's summary. Experiments were carried out in Alabama in 1953–55 on the control of *Heliothis zea* (Boddie) on sweet maize. In 1953 and 1954, when emulsion sprays were applied five and seven times, respectively, at three-day intervals, control increased as the rate of DDT per acre per application was increased from 1 to 2·5 lb., whereas higher rates of DDT did not give corresponding increases in control. The addition of 1·75 U.S. gals. mineral oil per acre to the spray significantly improved control, but caused foliage injury. In 1955, when sprays were applied to give 2 lb. DDT and 1 U.S. gal. mineral oil per acre, treatments were more effective at two-day than at three-day intervals and when begun on the first day after the first silks appeared than when begun on the second day. In a test to compare various types of spray nozzles, intervals between applications and rates of DDT, an interval of one day gave the best control, followed successively by intervals of two and three days, there was no difference in effect between flat-fan and agricultural-type nozzles, though both were better than hollow cones, and a dosage of 3 lb. DDT per acre was little better than 2 lb., when both were applied at three-day intervals.

Thurston (R.), Starks (K. J.) & Boush (G. M.). **Control of Green June Beetle Adults with Insecticides.**—*J. econ. Ent.* **49** no. 6 pp. 828–830, 2 refs. Menasha, Wis., 1956.

The adults of *Cotinis nitida* (L.) occasionally cause severe local damage to ripening grapes in Kentucky, and they were unusually abundant in the summer of 1955. When deposits of 18 of the newer contact insecticides, including phosphorus compounds, were tested against them in the laboratory, lindane [almost pure γ BHC], heptachlor, aldrin and endrin gave much higher kill in 24 hours than any of the others, and when lower concentrations were used, γ BHC proved much more toxic than heptachlor, and heptachlor

somewhat more toxic than aldrin; endrin was discarded on account of its persistence. A heavily infested vineyard was sprayed on 11th August, and 0·125 and 0·25 lb. γ BHC per 100 U.S. gals. water gave excellent, and 0·5 lb. heptachlor good, control, whereas 0·25 lb. heptachlor and 0·25 or 0·5 lb. aldrin gave poor results. Residue analyses of the sprayed grapes indicated that heptachlor and aldrin would not leave harmful residues, less than 1 part per million of either being found one day after treatment, and it is thought that the γ BHC residues would probably also be well below the tolerance.

Cox (H. C.), Lovely (W. G.) & Brindley (T. A.). **Control of the European Corn Borer with granulated Insecticides in 1955.**—*J. econ. Ent.* **49** no. 6 pp. 834–838, 3 figs., 5 refs. Menasha, Wis., 1956.

Lovely (W. G.), Cox (H. C.) & Brindley (T. A.). **Application Equipment for granulated Insecticides.**—*T. c.* pp. 839–846, 7 figs., 6 refs.

Fahey (J. E.), Rusk (H. W.) & Cox (H. C.). **Residues on Plants treated with DDT Granules and Emulsions for European Corn Borer Control.** —*T. c.* pp. 846–849, 1 fig., 5 refs.

The first of these papers contains an account of further tests of insecticides in granular form for the control of the first-generation larvae of *Pyrausta nubilalis* (Hb.) on maize in Iowa in 1955 [*cf. R.A.E.*, A **45** 104]; the population of the second generation was too low for reliable results to be obtained. In granules applied to maize in the whorl stage on 23rd June, when all plants showed signs of leaf-feeding, endrin, heptachlor, aldrin, dieldrin, isodrin and parathion, applied at 0·4, 1·5, 1, 0·4, 0·4 and 0·5 lb. per acre, respectively, gave better control than 1·5 lb. DDT in granules or emulsion spray, which did not differ in effect, and toxaphene and Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] at 2 lb. and EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] at 0·5 lb. were slightly less and 0·5 lb. Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate], 2 lb. malathion, 0·1 lb. rotenone and 8 lb. ryania were much less effective, though all caused highly significant decreases in population.

In a comparison of carriers for DDT, granules made from a soft type of attapulgite, tobacco-base or bentonite gave better control than those made from perlite, Celite, vermiculite or a harder attapulgite. One experiment showed no difference due to the size of the granules, but significantly better control was obtained in another with 30/60 mesh granules than with larger ones. In one test, differences in the machines used to apply the granules had no effect on control, but affected yield, whereas in another, some machines gave better control with hard and some with soft attapulgite. When granules containing 4, 7·5, 15 or 30 per cent. DDT were applied at 3·2, 6·3 or 12·6 lb. per acre, control increased with rate of application and, to some extent, with concentration, but was greater for high rates and low concentrations than for the reverse, and treatment with 4–7·5 per cent. granules at 15–20 lb. per acre is considered the most practical.

When 1–3 applications were made in June, granules were as effective as emulsion sprays for both DDT and malathion on sweet maize, and DDT granules gave better control and significantly higher yields than DDT sprays on field maize. Two or three applications were more effective than one, and the best control was given by applications begun on 14th June, when oviposition was practically complete and most of the plants showed leaf-feeding injury. Such applications raised the average yield from about 50 to 63 bushels per acre, the increase being significant.

The results of residue analyses of plant samples after the various DDT treatments are given in the third paper; they showed that the granules left most residue on the stalk and leaf axils and in the whorl and very little on the whorl tips or the leaves, whereas the sprays left much more on the whorl tips and the leaves than in the whorl or on the stalk and leaf axils [*cf.* **45** 105]. When applied once or twice in July or August against the second generation, DDT granules left more residue on the stalk and leaf axils and less on the husks than on the leaves, whereas sprays left most on the leaves. Animals feeding on maize stover generally prefer the leaves and husks, and these together showed averages of 14 and 136·4 parts per million DDT after treatment with granules and sprays, respectively. Residues were heavier from granules made with soft attapulgite and Celite (30/60 mesh) than from those made with the other carriers, but showed no consistent difference due to particle size.

The various machines used to distribute the DDT particles and their performance in the laboratory and in the field tests are discussed in the second paper. All proved suitable, with little difference in residue and no serious breakdown of the granules during application. Some of the general requirements for such machines are listed.

Brazzel (J. R.) & Gaines (J. C.). **The Effect of Pink Bollworm Infestations on Yield and Quality of Cotton.**—*J. econ. Ent.* **49** no. 6 pp. 852–854, 1 graph, 1 ref. Menasha, Wis., 1956.

Experiments were carried out in Texas in 1955 to compare the losses in cotton quality and yield resulting from various levels of infestation by *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) in the absence of other pests. Plots, 24 sq. yards in area, containing cotton plants from which all squares had been picked, were sprayed to destroy any insects present and covered with cages on 4th June; 2, 6 or 15 adults of *P. gossypiella* of both sexes were released on them on 18th and 24th June and 2nd July, and infestation records were taken at intervals of 5–7 days from 30th June until 1st August, when practically all the bolls were infested and the numbers of larvae per boll averaged 6·4, 9·6 and 12·9, respectively. The plants were defoliated chemically on 6th August and the cotton harvested on 22nd August, and examination of lint and seed showed that all levels of infestation reduced both quality and yield; at the two lower levels, losses were mainly due to reduction in quality, whereas at the highest they were due mostly to reduction in yield. It is pointed out that the levels of infestation tested were much higher than would normally occur in the field.

Taylor (E. A.) & Smith (F. F.). **Transmission of Resistance between Strains of Two-spotted Spider Mites.**—*J. econ. Ent.* **49** no. 6 pp. 858–859, 4 refs. Menasha, Wis., 1956.

The authors describe preliminary cross-breeding experiments with three strains of *Tetranychus telarius* (L.), one of the carmine form from Beltsville, Maryland, and two of the green form, from Waltham, Massachusetts, and Cranbury, New Jersey, respectively [*cf. R.A.E.*, A **44** 20], of which the first two were susceptible and the last resistant to organic phosphorus compounds. Dipping tests with malathion at concentrations ranging from 1:100 to 1:40,000 showed that a concentration of 1:5,000 consistently gave complete mortality of the susceptible and no mortality of the resistant mites, and this was therefore used to test the resistance of the progeny resulting from each of the possible crosses. F_1 females from all crosses including a resistant parent were resistant, indicating that the character for

resistance was transmitted by either sex, whereas those from crosses of suspectible strains were susceptible; the haploid males in all cases showed the same susceptibility or resistance as the female parent. F_1 females from all crosses involving the carmine form produced no eggs and thus appeared to be sterile, so that this and the green form may be distinct species [*cf. loc. cit.*], but F_1 females from crosses of the green strains produced abundant eggs, giving rise to both males and females. Mating these F_1 females with haploid males from a resistant maternal parent resulted in resistant backcross females, and mating them with haploid males from a susceptible maternal parent in equal numbers of resistant and susceptible backcross females, indicating that resistance is a dominant character and probably involves a simple factor. The factor for carmine colour was transmitted to the F_1 generation in the same way as that for resistance.

Robertson (R. L.) & Arant (F. S.). **The Effect of certain Acaracides on two Species of Spider Mites on Cotton.**—*J. econ. Ent.* **49** no. 6 pp. 860–861, 7 refs. Menasha, Wis., 1956.

Experiments on the chemical control of Tetranychid mites on cotton were carried out in 1954 in three localities in Alabama, where they had been numerous for some years. Dusts were applied against *Tetranychus desertorum* Banks in the south-east at 20 lb. per acre on 22nd, 26th and 28th July, and counts made before and two days after the first application showed that all gave highly significant control; 3–5 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 5 per cent. malathion, 3 per cent. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], 3 per cent. methyl-parathion and 1 per cent. parathion were significantly more effective than 97 per cent. sulphur. Infestation increased so much 3–4 days after the first application that the second was required, and as this was followed immediately by rain, the third was made. The organic compounds were again more effective than sulphur, but none eliminated the mites and none showed much toxicity to the eggs; 5 per cent. Aramite had the greatest residual effect.

Sprays were applied at 6 U.S. gals. per acre against *T. desertorum* in central Alabama on 4th August. Ovex [p-chlorophenyl p-chlorobenzenesulphonate] at 2 lb., demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], methyl-parathion and parathion at 0·25 lb. and Chlorthion and malathion at 0·5 lb. per acre all gave significant control for two days, with no significant difference between them, but the population decreased so much on the untreated plots on the third day that the experiment was discontinued. The predacious thrips, *Scolothrips sexmaculatus* (Perg.) was observed feeding on the mites in this area, but it is doubtful whether it afforded much control. The same sprays and one of 0·25 lb. Hercules AC-528 (2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)) per acre gave good control of *T. atlanticus* McG. in northern Alabama for six days after application on 24th August, with no significant difference between them. A decline in population after 30th August prevented the determination of further residual action.

Hamilton (D. W.). **Resistance of the Codling Moth to DDT Sprays.**—*J. econ. Ent.* **49** no. 6 pp. 866–867, 3 refs. Menasha, Wis., 1956.

In view of the reported development of resistance to DDT in *Cydia* (*Carpocapsa*) *pomonella* (L.) in Ohio [*cf. R.A.E.*, A **42** 399] and other parts of the

United States [*cf.* also **44** 384], 16 strains of the moth from orchards in which DDT had been applied heavily, moderately, for one season only or not at all were tested for susceptibility to the insecticides in 1953–55. Apples were sprayed on the trees in the first two years and in the laboratory in the third, and infested in the laboratory with newly hatched larvae in July or August. In 1953, apples sprayed with 0·75 lb. 50 per cent. wettable DDT per 100 U.S. gals. were found to bear deposits of 3·2 and 2·8 μg. DDT per sq. cm. immediately and after a week, respectively; larvae of three strains from heavily and moderately sprayed and unsprayed orchards in Kentucky, Illinois and Indiana, respectively, showed differences in vigour, as measured by their ability to enter unsprayed fruits, and they were readily killed by the fresh deposits; differences resulting from exposure to the weathered deposits were not related to the histories of exposure to the insecticide in the field. In 1954, when seven other strains were tested, fruits sprayed with 0·5, 0·75, 1 or 2 lb. 50 per cent. DDT showed fresh deposits of 3, 4·8, 4·1 and 10·7 μg. per sq. cm.; only the last prevented entry by larvae of a strain from Washington that had been exposed to DDT for several years and had received six ineffective applications in 1953, whereas all practically prevented entry by six strains from Washington, Indiana and California that had been less exposed. Weathered deposits of 3·1 and 7 μg. per sq. cm. had little effect on the first strain, but prevented entry by the others in most instances. In 1955, fresh deposits of 3·8, 5 and 8·4 μg. per sq. cm. from sprays of 0·5, 1 and 2 lb. 50 per cent. DDT were ineffective against the resistant and one other strain from Washington that had been exposed to DDT for several years, but effective against another that had received no DDT and against five strains from Kentucky and Indiana. When tested against one from the district in Ohio in which resistance had been reported, the two higher deposits were ineffective. Limited tests indicated that adults of strains resistant in the larval stage might also be resistant, 75 and 25 per cent. of adults of susceptible and resistant strains being dead 24 hours after exposure for one hour to surfaces dipped in a DDT spray.

It is concluded, from these and the field observations, that although other factors are responsible for much of the failure to obtain control [*cf.* **43** 310], some resistance to DDT may have developed in southern Indiana, southern Illinois and Kentucky.

Scott (L. B.). **Tests with new Insecticides to control Green June Beetle Larvae in Tobacco-plant Beds.**—*J. econ. Ent.* **49** no. 6 pp. 868–869, 7 refs. Menasha, Wis., 1956.

The larvae of *Cotinis nitida* (L.), which feed on organic matter in the soil, uproot tobacco seedlings in plant beds in north-central Tennessee, and experiments on their control [*cf. R.A.E.*, A **37** 243] were carried out in 1945–53. The larvae were active when night temperatures did not fall below 60°F., but tended to remain in the soil and did not come in contact with insecticides applied to the surface at lower temperatures. However, surface treatments remained effective for several days, so that many larvae were killed after a week or more. Quantities given are per 100 sq. yards. Dusts were applied with a cloth sack, fumigants were poured into holes, which were immediately covered, baits, slightly moistened, were broadcast by hand at 12–18 lb., and drenches were applied from a sprinkling can at 54 U.S. gals.

Parathion was the most effective of the insecticides tested, giving 97 per cent. mortality when applied at 1·1 oz. in a bait of wheat middlings and bran (1:1) containing 0·4 per cent. insecticide; it was effective at 0·2 oz. in a 1 per cent. dust when temperatures remained above 60°F., and at

18 oz. in a drench, but these were slightly less effective than the bait. A drench of 28 oz. DDT in 0·4 per cent. emulsified solution also gave 97 per cent. mortality, but 18–72 oz. malathion in a drench and 1·2 oz. in a dust, 0·5 oz. aldrin or dieldrin, 2·4 oz. chlordane, lindane [almost pure γ BHC] or DDD (TDE), 0·2 oz. endrin or 4·8 oz. toxaphene in dusts, 2 oz. DDT in a bait and 1 U.S. gal. D-D mixture [1,3-dichloropropene and 1,2-dichloropropane] or 14 U.S. gals. petrol applied as a fumigant, though toxic, were less so than parathion; a barium-fluosilicate bait was moderately effective.

Reid jr. (W. J.) & Cuthbert jr. (F. P.). **Biology Studies of the Pickleworm.** —*J. econ. Ent.* **49** no. 6 pp. 870–873, 9 refs. Menasha, Wis., 1956.

Diaphania nitidalis (Stoll) is injurious to cucurbits in South Carolina, and investigations on its habits were made in 1948–54 in conjunction with tests of insecticides for its control; all stages of this Pyralid, its life-history and seasonal occurrence and the nature of the injury caused are described [*cf. R.A.E.*, A **46** 14]. It does not survive the winter in this state, but spreads northward each year from semi-tropical areas to the south [*cf. loc. cit.*]. A few larvae were observed in the Charleston area during May and early June, and numbers gradually increased until late autumn. All species of cucurbits examined, including a wild one, were infested, and summer squash, cucumbers and cantaloupe melons were severely damaged in late summer and autumn. Oviposition occurred at night, chiefly after fruiting began, and very few adults were seen in cultivated fields during the day, when they probably shelter on trees and high bushes near the fields. The larval and pupal stages and complete development lasted 9–28, 6–31 and 22–53 days, respectively, in field cages. Fertile eggs were not obtained in the cages, but those collected in the field hatched within three days. Characters are given by which other moths that are sometimes associated with *D. nitidalis* can be distinguished from it, and it is concluded that careful surveys to the south might enable infestations to be predicted, that early sowing might reduce injury, and that frequent applications of insecticides might be necessary for control, but that they could be delayed until the flowers appear, when the moths begin to oviposit freely.

Richmond (C. A.). **Tests with Phosphorus Insecticides for Control of Pink Bollworm and some other Cotton Pests, 1955.**—*J. econ. Ent.* **49** no. 6 pp. 874–875, 2 refs. Menasha, Wis., 1956.

The results are given of experiments carried out in Texas in 1955, in which endrin and various phosphorus insecticides [*cf. R.A.E.*, A **44** 167; **45** 407] were compared with mixtures of DDT and dieldrin, for the control of cotton pests, notably *Platyedra* (*Pectinophora*) *gossypiella* (Saund.), infestation by which was heavy. Amounts of insecticide are given per acre. Emulsion sprays were applied at 6 U.S. gals. at seven-day intervals, except when showers intervened, and in one test, Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate], at 0·98 lb. alone or at 0·53 lb. with 1·07 lb. DDT, gave the best control of *P. gossypiella*, followed by 0·5 lb. Bayer 16259 [O,O-diethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate], 0·49 lb. Bayer 17147 and a mixture of 0·26 lb. dieldrin and 2·06 lb. DDT, which were almost equal in effect; endrin at 0·4 lb. alone and at 0·25 lb. with 0·5 lb. DDVP [dimethyl 2,2-dichlorovinyl phosphate] and 2 lb. Aroclor 5460 (a chlorinated terphenyl) afforded little control. The first two formulations were also effective, though not significantly more so than others, in preventing injury to the bolls by *Heliothis zea* (Boddie), and the phosphorus compounds gave good control of a light

infestation of Aphids. The dieldrin mixture resulted in the highest yield, and 0·98 lb. Bayer 17147 in the lowest.

In another test, Bayer 17147, at 1·1 or 0·48 lb. alone or at 0·26 lb. with 1 lb. DDT, and 0·26 lb. dieldrin with 2·1 lb. DDT were equally effective against *P. gossypiella*, but 0·38 lb. endrin gave only slight control; all gave good control of *Anthonomus grandis* Boh., with no significant difference between them, all but 0·48 lb. Bayer 17147 reduced boll injury by *H. zea*, and Bayer 17147 controlled a light infestation of Aphids and mites. The mixture of dieldrin and DDT resulted in the highest yield, and 0·48 lb. Bayer 17147 and endrin in much the lowest. Differences in yield could not be attributed entirely to insect control, as the field was unevenly irrigated and there were considerable variations in the growth of the cotton.

Clark (E. W.) & Lukefahr (M. J.). **A partial Analysis of Cotton extrafloral Nectar and its Approximation as a nutritional Medium for adult Pink Bollworms.**—*J. econ. Ent.* **49** no. 6 pp. 875–876, 8 refs. Menasha, Wis., 1956.

Lukefahr (M.) & Griffin (J. A.). **The Effects of Food on the Longevity and Fecundity of Pink Bollworm Moths.**—*T. c.* pp. 876–877, 5 refs.

Since adults of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) will feed on sugar solution in the laboratory, they may also feed in the field, and the investigations described in the first of these papers were carried out to determine what carbohydrates are available in cotton fields and their value to the insect. Honeydew from Homoptera and secretions from the floral nectaries are readily available only intermittently, and the latter only during the day, when the moths are inactive, but extrafloral nectaries on the bracts or leaves are present throughout the season. Chromatographic analyses of the nectar from these showed the presence of appreciable amounts of sucrose, glucose and fructose and traces of ribose, rhamnose and raffinose; no amino acids were found. Solutions of these sugars in the appropriate proportions were readily taken by the adults from the first night after emergence. The diet had no effect on length of life, but doubled the number of eggs laid.

Further details are given in the second paper, which contains an account of tests to compare the nutritional value of the simulated nectar with that of a mixture of honey and molasses (1 : 1), the same with 5 per cent. protein hydrolysate, and water. Statistical analysis of the results showed no significant differences in length of life for males or females, in the number of mature eggs remaining in the females at death or in the percentage of females that paired and oviposited. Significantly more eggs were laid by females that fed on the simulated nectar than by those provided with water only, the averages being 146 and 68, respectively, and the numbers from those receiving the honey mixtures were between these extremes and not significantly different from either. A nectarless variety of cotton has been developed in North Carolina, and further investigations, including field tests, with such varieties are recommended, with a view to reducing the rate of increase of the moth.

Luckmann (W. H.). **Observations on the European Corn Borer and the Corn Earworm infesting early-season Plantings of Country Gentleman Sweet Corn.**—*J. econ. Ent.* **49** no. 6 p. 877, 2 refs. Menasha, Wis., 1956.

Insecticidal control of *Pyrausta nubilalis* (Hb.) and *Heliothis zea* (Boddie) on Country Gentleman sweet maize has been poor in Illinois, apparently

largely owing to late sowing. Before 1954, this maize was generally not sown until 20th May, because its main variety germinates poorly in cool soil, and it therefore silked and matured during the period of greatest egg deposition by the two moths. In investigations in 1954, it was sown on sandy soil well before 20th May, and the plants were too young for infestation by the first generation of *P. nubilalis* and too mature for the second generation of *P. nubilalis* or *H. zea*. As a result, the infestation was not heavy, and insecticides gave good control. In 1955, some sown on 30th April received only 13·4 per cent. of all the first-generation eggs of *P. nubilalis* in the area, and some that was sown on 8th or 10th May received no treatment against the first generation of *P. nubilalis* and usually only one or two treatments against the second generation and *H. zea*. An average of 90·5 per cent. of the ears on these crops were free from insect damage.

Lukefahr (M.). **A new Host of the Boll Weevil.**—*J. econ. Ent.* **49** no. 6 pp. 877–878, 5 refs. Menasha, Wis., 1956.

Anthonomus grandis Boh. is commonly thought to develop on few plants other than species of *Gossypium* [*cf. R.A.E.*, A **22** 636], but it was found attacking *Thespesia populnea* [*cf.* **44** 156] in a garden in Texas in July 1956, when abundant cotton was available in neighbouring fields. Adults were present on the foliage, and the larvae infested the flower-buds and seed pods and gave rise to normal adults, indicating that the food supply was adequate. When the adults were caged with cotton plants, they soon made feeding or egg punctures in all fruiting forms.

Hastings (A. R.). **Granulated Endrin for White-pine Weevil Control during Hibernation.**—*J. econ. Ent.* **49** no. 6 p. 878. Menasha, Wis., 1956.

The author describes experiments in the north-eastern United States in which doses of 1, 2 or 4 lb. actual endrin per acre in granules were applied evenly to the surface of the débris in plots of white pine [*Pinus strobus*] on 10th October 1955, for the control of adults of *Pissodes strobi* (Peck) entering it for hibernation. Weevils were caged over treated or untreated soil, provided with fresh pine twigs for food, and left undisturbed until 2nd April 1956. Further twigs were then provided, and the cages were examined daily until 11th April, when emergence ceased. Only 0–1 per cent. of the weevils caged on the treated soil emerged, as compared with 94 per cent. from the untreated.

Evans (W. G.) & Gyrisco (G. G.). **Notes on the Biology of the Pea Aphid.**—*J. econ. Ent.* **49** no. 6 pp. 878–879, 6 refs. Menasha, Wis., 1956.

Little attention is usually paid to the fact that *Macrosiphum pisum* (Harris) is a holocyclic Aphid, normally overwintering in the egg on perennial leguminous plants and migrating to annual ones in spring and back in autumn [*cf. R.A.E.*, A **4** 33; **42** 127], but attempts to transfer it from broad beans (*Vicia faba*) to lucerne in the greenhouse in spring, autumn or winter were unsuccessful in 1948–53 in New York, except in one test in which the lucerne was exposed to a light intensity of 10,000 foot-candles,

when some of the Aphids remained on the plants and reproduced slowly. Fundatrices brought from lucerne in the field in April 1954 and sexuparae brought in during November 1954 reproduced readily on lucerne in the laboratory. In view of the possibility that the Aphids maintained on broad bean in the insectary were of the summer form (alienicolae), several of the plants were transferred to a temperature of 35–50°F. in January 1955, in an attempt to produce sexuparae. The plants did not grow appreciably under these conditions, but the Aphids fed and reproduced. After five weeks, the latter were transferred to lucerne, on which they settled immediately and reproduced more rapidly than on the dormant bean plants, indicating that sexuparae had been produced.

It is concluded that the Aphid is normally migratory in New York, but that the fundatrices, fundatrigeniae, sexuparae and sexuales can probably survive on leguminous annuals in the greenhouse. The winged migrants are probably intermediate in their food preferences, but the summer form prefers only the succulent growth of the annuals. Small populations of the Aphid are found on lucerne in the field during summer, possibly because the plants then approach peas and beans in nutritional value, and this would explain why some of the alienicolae reproduced on lucerne subjected to a high light intensity.

Reid jr. (W. J.) & Cuthbert jr. (F. P.). **Resistance of the Southern Potato Wireworm to Insecticides.**—*J. econ. Ent.* **49** no. 6 pp. 879–880, 2 graphs, 1 ref. Menasha, Wis., 1956.

Investigations on wireworms as pests of vegetables, particularly potatoes, in the coastal plains of the south-eastern United States were begun at Charleston, South Carolina, in 1952. The most abundant in the potato-growing areas is the southern potato wireworm, *Conoderus falli* Lane, formerly known as *C. vagus* (Cand.) [*cf. R.A.E.*, A **42** 310; **44** 123] [which Lane (1956) tentatively considers a synonym of *C. falli*]. This species was effectively controlled at Charleston in 1952–54 by 2 lb. aldrin, dieldrin or heptachlor or 4 lb. chlordane per acre, broadcast over the surface and disked or harrowed into the soil shortly before the crop was planted in January or February, and chlordane treatments were widely adopted. All four insecticides were less effective in 1955, and still less so in 1956, when 5 lb. chlordane and 2·5 lb. dieldrin per acre gave effective control only of low populations. In laboratory tests with wireworms from potato fields that had received several annual applications of chlordane and from fields in the neighbouring county, where little or no chlordane or other soil insecticide had been used, individual larvae were caged in March 1956 with untreated soil or soil treated with chlordane at doses equivalent to 1, 4, or 8 lb. per acre to a depth of six inches, provided with food and moisture and examined weekly until 3rd August, when all survivors had transformed to adults. The two higher doses caused about 15 and 30 per cent. mortality of the Charleston strain, as compared with about 12 per cent. for no treatment, but almost complete mortality of the larvae from the other county.

It appears, therefore, that the wireworm has become resistant to chlordane in Charleston county and at least moderately resistant to aldrin, dieldrin and heptachlor, although there was little commercial application of these before 1956. Limited studies indicated that the wireworm has not more than two generations a year, and such a rapid development of resistance in an insect with a relatively long life-cycle is considered unusual. No evidence of increased resistance to DDT has been observed in it, and the Gulf wireworm, *C. amplicollis* (Gylh.), which appears to be second in

economic importance in the area [*cf.* **44** 123], showed no tendency to develop resistance to any of the insecticides.

Howe (R. W.) & Burges (H. D.). **Studies on Beetles of the Family Ptinidae. 10. The Biology of** *Mezium affine* **Boieldieu.**—*Ent. mon. Mag.* **89** no. 1072 pp. 217–220, 3 graphs, 9 refs. London, 1953. **11. Some Notes on** *Ptinus villiger* **Reit.**—*Op. cit.* **91** no. 1090 pp. 73–75, 8 refs. 1955.

Howe (R. W.). **12. The Biology of** *Tipnus unicolor* **Pill. and Mitt.**—*T. c.* no. 1097 pp. 253–257, 1 graph, 16 refs.

Howe (R. W.) & Bull (J. O.). **13. The Oviposition Rate of** *Pseudeurostus hilleri* **(Reitt.).**—*Op. cit.* **92** no. 1103 pp. 113–115, 1 graph, 3 refs. 1956.

It is stated in the first of these four parts of a series on Ptinids associated with stored products [*cf. R.A.E.*, A **41** 443, etc.] that *Mezium affine* Boield., which is presumably native to Britain, appears to be less widespread there than formerly. In laboratory cultures, mortality was high (33–100 per cent.) among the eggs, some of which were probably eaten by the newly hatched larvae, and also among the larvae (6–30 per cent.), which were reared on wheatfeed. At 70 per cent. relative humidity, no eggs hatched at 5 or 10°C. [41 or 50°F.], and the larvae failed to develop at 13 and 35°C. [55·4 and 95°F.]. Development was completed at intermediate temperatures, its duration being about the same at both 33 and 30°C. [91·4 and 86°F.] but increasing as the temperature decreased to 20°C. [68°F.]; eggs developed faster at 25°C. [77°F.] than at 35°C. At 25°C., only one of 25 larvae became adult at 100 per cent. relative humidity, but development was satisfactory at humidities between 30 and 80 per cent., its duration increasing as humidity fell. At 25°C. and 70 per cent. relative humidity, females oviposited for up to 88 weeks and laid an average of 460 eggs each. The number per female per week remained at about ten for nearly 20 weeks, decreased to about six during the next 40 weeks, and then quickly fell to a low level. Although this Ptinid is more fertile and longer lived than some others, its intrinsic rate of increase [*cf.* **41** 311] appears to be lower, partly because of its slow development and high mortality, but also because few eggs are laid during the latter part of life. An experiment in 1950–52 with wheatfeed in bins in an unheated summerhouse showed that *M. affine* is able to double or treble its numbers in a year in the absence of severe competition from other insects. The two winters passed were not sufficiently cold to kill a native species, and though it appears that a warmer climate would be more favourable for *M. affine*, a tropical one would be too hot.

The work described in the second part was carried out to determine whether *Ptinus villiger* Rttr., which is an important pest, especially of flour, in Canada [*cf.* **23** 542; **38** 55] and has occasionally been intercepted in Canadian produce at British ports, is likely to become established in Britain. Smallman & Gray found that in Manitoba some of the larvae complete their development before winter and those that overwinter give rise to adults late in the following summer, although some pupate in spring and others not until after a further period of feeding. Attempts to establish cultures in Britain from half-grown larvae obtained from Canada in 1947 failed, but limited success was achieved with a second consignment received in 1951 and thought to be of the diapausing strain. The culture was reared on wheatfeed or vitamin-fortified flour, placed in a refrigerator for some weeks during winter, and kept at a temperature of 17·5–20°C. [63·5–68°F.] and a relative humidity of 70 per cent. during the summer. At 25°C. and 70

per cent. relative humidity, the egg and pupal stages each lasted 12 days; four larvae reared on flour pupated in 35–36 days and two on wheatfeed in 39 days. Adults from larvae reared on wheatfeed emerged from their cocoons after 76 days, but others reared on flour had not emerged after four months. At 90 per cent. relative humidity, the combined egg and larval stages, the pupal stage and the period prior to adult emergence lasted 46–51, 12 and 63·5 days, respectively. At 20°C. and 70 per cent. relative humidity, 26 half-grown larvae pupated in an average of 22 days, from which the total larval period is estimated to be 50–60 days; the mean pupal stage and the pre-emergence periods for males and females lasted 15·9, 29·6 and 22·1 days, respectively. Another 26 larvae entered diapause under these conditions and were subjected to various temperature treatments after a year in an attempt to break it. Two of eight transferred to 25°C. pupated between one and two months later and one of three kept at 4°C. [39·2°F.] for a month and then transferred to 25°C. pupated after 11 days; the pupal stage of one of these three lasted 69 days. Other methods of breaking diapause were unsuccessful, and some diapausing larvae lived for three years before dying. In Canada, the adults survive the winter in the spaces under the floors of warehouses, where the temperature reaches −15°C. [5°F.], but the more resistant larvae are able to survive in the warehouses themselves in bags of flour. Since such a period of chilling in the adult and, possibly, the larval stage appears obligatory, this species is unlikely to become established in Britain.

It is stated in the third paper that *Tipnus unicolor* (Pill. & Mitt.) is widespread in Britain, but nowhere abundant, though it appears to be commoner in the north. At 70 per cent. relative humidity in the laboratory, eggs hatched at 10 but not at 27·5°C. [81·5°F.]. The duration of the egg stage varied from about 15 days at 25°C. to about 26 at 15°C. [59°F.], about 60–70 per cent. of the eggs hatching. At 17·5, 20 and 22·5°C. [72·5°F.], the larval stage averaged 70–80 days, and at 15°C. it was about 130 days; the optimum temperature for larval development was between 17·5 and 20°C. The mean duration of the pupal stage decreased from 21·5 days at 15°C. to 14 at 25°C., but the pre-emergence period of the adults was little affected by temperature. The average numbers of eggs laid per female were 48, 100 and 129 at 25, 20 and 17·5°C. Only one egg hatched at 25°C., but at the other two temperatures the hatching rates were 45 and 50 per cent. and oviposition continued for up to 50 and 65 weeks, respectively; at both temperatures, it fluctuated about a maximum for some 25 weeks and then fell over about 15 weeks to a low level. At 25°C., it ceased after 15 weeks, though females transferred to a temperature of 22·5°C. five weeks later again laid eggs, most of which were infertile. It is concluded that the optimum temperature for *T. unicolor* is about 17·5°C., which is lower than for the other Ptinids studied and is the approximate mean daily temperature in southern England in July and August. The intrinsic rates of increase corresponded to weekly population increases of 12·5 and 12 per cent. at 17·5 and 20°C., respectively.

In the fourth paper, an account is given of work to determine the oviposition rate of *Pseudeurostus* (*Eurostus*) *hilleri* (Rttr.) at 20°C., carried out because this Ptinid was found to lay few eggs at 25°C. At 70 per cent. relative humidity, the females oviposited for up to 32 weeks, the average number of eggs laid per female per week exceeding six for some 15 weeks and reaching a maximum of about ten, and 82 per cent. of the eggs hatched. At 25°C., a mean of 15 and a maximum of 33 eggs per female were obtained in 20 weeks. The intrinsic rate of increase at 20°C., calculated from these and other investigations, was found to be equivalent to 27 per cent. weekly. This is higher than for any other Ptinid infesting warehouses in Britain except *Ptinus tectus* Boield., for which the rate is 32 per cent.

Dobson (R. M.). **A new Species of *Carpophilus* Stephens (Col., Nitidulidae) associated with Stored Products.**—*Ent. mon. Mag.* **92** no. 1101 pp. 41–42, 1 fig., 5 refs. London, 1956.

Carpophilus freemani, sp. n., is described from adults of both sexes found in December 1954 on Brazil nuts that originated in Brazil or Bolivia and were imported from Brazil to Hull, where they had been in store for eight months. It is also recorded from maize spillage at a farm in Iowa, where it was found in September 1954, and from Rabat, Morocco. Characters separating it from *C. mutilatus* Erichs. [*cf. R.A.E.*, A **42** 256] are shown in a table.

Vité (J. P.). **Populationsstudien am Lärchenblasenfuss *Taeniothrips laricivorus* Krat.** [Studies on the Population of the Larch Thrips, *T. laricivorus*.]—*Z. angew. Ent.* **38** pt. 4 pp. 417–448, 18 figs., 40 refs. Berlin, 1956.

A detailed account is given of observations in mixed forests near Göttingen in 1953–54 showing that *Taeniothrips laricivorus* Krat. & Farský, which is a serious pest of larch in many parts of central Europe, has two generations a year and overwinters as adult females, principally on spruce [*cf. R.A.E.*, A **44** 207]. The density of the overwintering population varied with the composition of the stand and, on a given tree, with the amount of shelter available in the crown; young spruces were preferred. In 1954, the overwintered females resumed activity at the end of April or the beginning of May, some four weeks after the new shoots appeared on larch, and moved to larch during a period of prolonged warm weather. They first appeared in the middle zone of the crown, but spread to the topmost shoots during the second week of May, ovipositing in the needles, at first on short shoots, since the long shoots had not yet developed, and later on the latter. There was further movement, particularly in sultry weather, from spruce to larch and also from larch back to spruce, since considerable damage had been done to larch by *Coleophora laricella* (Hb.) and this had been accentuated by the dry weather, whereas the new growth on spruce was already well developed by the second week in May. Oviposition, which occurred also to a certain extent on spruce, continued until about 19th May, when the warm weather ended. Most of the nymphs of the first generation had hatched by about 5th June, and the adults emerged from 19th to 25th June. Pairing occurred immediately, and oviposition was well advanced by 24th June, again during warm weather, occurring on the long shoots throughout the crown. Few females of this generation oviposited on spruce. Adults of the second generation emerged from 30th July to 5th August, and paired, after which most of the females migrated to spruce to overwinter. The egg, larval and pupal stages lasted 8–14, 12–16 and 8–10 days, respectively, development being completed in about 40 and 35 days in the two generations, respectively.

The main damage was caused by the second-generation nymphs in July, when the shoots became split, needles withered and growth was frequently impeded. The number of thrips per shoot varied from 0 on shoots 1 mm. thick to 50 or more on some with a thickness of 3 mm. and over. The groups of needles at the ends of the long shoots contained about 50 per cent. of the total population present on the trees during the second generation. Stands 11–19 years old were the most affected, and the most vigorous trees received most damage, but variation in altitude between about 700 and 1,700 ft. had little effect on infestation.

Since it had been supposed that the thrips has only one generation a year at high altitudes, comparative studies were made in larch stands at 2,600–3,600 ft. at Lunz, in Lower Austria. These showed that two generations

occurred in the year, but that development was delayed by about a month there as compared with north-western Germany, owing to the lower night temperatures, and that the damage caused was correspondingly less. Exposure to strong winds was unfavourable for infestation.

Lassack (H.). **Die Ausbreitung der Rübenkräuselkrankheit und ihres Vektors, der Rübenblattwanze,** *Piesma quadrata* **Fieb. (Heteropt. Piesmid.) in Niedersachsen.** [The Spread of the Beet Leaf-crinkle Disease and its Vector, *P. quadratum*, in Lower Saxony.]—*Z. angew. Ent.* **38** pt. 1 pp. 67–72, 2 maps, 11 refs. Berlin, 1955. **Verhaltensbiologische Untersuchungen an der Rübenblattwanze** *Piesma quadrata* **Fieb.** [Investigations on the Behaviour of *P. quadratum*.]—*T. c.* pt. 4 pp. 449–467, 1 graph, 10 refs. 1956.

In the first paper, the author states that the beet leaf-crinkle disease, which, with its vector, *Piesma quadratum* (Fieb.), has been spreading westwards in Germany for some years [*cf. R.A.E.*, A **21** 8], was observed for the first time in the Federal Republic near Helmstedt in 1945. It had spread westward to the Weser and northwards almost to Lüneburg by 1953 and had crossed the Weser by 1954. The bug prefers light soils, and there was no spread to the south, where heavy soils occur. Damage is greatest in the drier eastern part of the area, where coniferous forests offer ample opportunity for overwintering, whereas further to the west the sowing of the beet crop is delayed, the spring migration of the overwintered adults begins later and adults of the new generation leave the fields earlier for hibernation.

The second paper contains an account of laboratory experiments on the effects of temperature, light and wind on the movements of the bug, carried out to elucidate its spread in the field. Adults in a temperature apparatus preferred a temperature of 15–19°C. [59–66·2°F.], became very active at 30°C. [86°F.] and died at about 40°C. [104°F.]. When they were placed at an air temperature of 19·5°C. [67·1°F.] on a heated plate, flight was induced in 40 per cent. of the bugs when the temperature of the plate reached 38°C. [100·4°F.]. For constant plate temperatures of 19–34°C. [66·2–93·2°F.], flight increased with air temperature. The adults preferred semi-darkness to light when on a horizontal surface, and light had the effect of accelerating movement. In flight, they were positively phototactic and were attracted to the broadest and best defined contour. They avoided wind and were prevented from flying by wind speeds above 2·2 miles per hour. These laboratory observations were largely confirmed in the field, and it is shown how the reactions of the insect to the various factors studied influence its behaviour throughout the season. It is concluded that meteorological conditions impose little limitation on ground movement, but that directed flight is possible only in the absence of wind. Temperature conditions are most favourable for flight in the afternoon. At that time, the phototactic reaction of the insects will lead them to fly to the west, and since the prevailing wind is also in that direction, a westerly spread results.

Györfi (J.). **Die in den Maikäfer- und anderen Blatthornkäferlarven schmarotzenden Wespen.** [Hymenoptera parasitising Cockchafer and other Lamellicorn Larvae.]—*Z. angew. Ent.* **38** pt. 4 pp. 468–474, 4 figs. Berlin, 1956.

The chief parasites of Lamellicorn larvae are Scoliids, notably species of the genus *Tiphia*, and attempts have been made in several parts of the world to use them for purposes of biological control. Four species of *Tiphia*

occur in Hungary, *T. femorata* F., *T. morio* F., *T. polita* Costa (*ruficornis* Klug) and *T. minuta* Linden. Observations showed that the adults feed almost exclusively on honeydew in spring and on pollen, nectar and other plant juices in summer. They are particularly attracted to umbelliferous plants, especially carrot and parsnip, and can be found on them in large numbers during the forenoon. They do not move far from such plants, and in 1943–44 the author observed heavy parasitism by *T. femorata*, *T. morio* and *T. polita* of the larvae of *Amphimallon* (*Rhizotrogus*) *solstitiale* (L.) and *Melolontha melolontha* (L.) (*vulgaris* F.) feeding on the roots of meadow plants in the neighbourhood of carrots in flower, but none a few miles away where there were no carrots. The adults are long-lived, surviving for 20–26 days in captivity, and the females enter the soil each day to oviposit on suitable larvae, which are those in the later stages of growth, oviposition reaching its peak in July and early August. The females laid 40–50 eggs each, and the larvae hatched in 7–10 days and fed externally for 28–32 days, after which they spun cocoons in the soil. Most species overwinter in the cocoons before pupating, but *T. femorata* does so in the pupal stage. Some parasitism is also afforded by species of other genera, notably *Scolia*. Their habits are similar to those of *Tiphia* spp., but the *Scolia* females drag the paralysed larvae to depths of as much as 3 ft. before ovipositing on them.

Édel'man (N. M.). **The Biology of *Lymantria dispar* (L.) under Conditions of the Kuba District of the Azerbaijan SSR.** [*In Russian.*]—*Zool. Zh.* **35** pt. 4 pp. 572–582, 1 graph, 26 refs. Moscow, 1956. (With a Summary in English, suppl. p. 10.)

Since *Lymantria dispar* (L.) infests both deciduous forest trees and fruit trees, investigations were carried out in 1953 on its bionomics in the mountainous Kuba district of Azerbaijan, where it is common in forests and is likely to spread from them to neighbouring orchards. Observations in the forests showed that the eggs were laid not only on the lower, but also on the upper parts of the trunks, at heights ranging up to nearly 40 ft. on beech, many being laid also on the lower surfaces of the branches. Hatching began on 23rd–25th April and was completed in 7–9 days. The larval stage lasted 55–60 days, pupae were first observed on 25th June, and adults emerged on 12th July. In the laboratory, the larval and pupal stages averaged 46·7 and 12 days, respectively, and adults emerged on 22nd June. Oviposition began immediately and continued for 8–12 days.

Some of the forest stands contained considerable proportions of wild fruit trees, and it was found that the trees mainly infested in these comprised hornbeam, oak, apple and hawthorn [*Crataegus*]. In a mixed stand, larvae in the first two instars were much the most numerous on oak, but in the fourth instar, the numbers decreased on oak and increased on hornbeam, apple and hawthorn. In the fifth instar, only 12–13 per cent. of the larvae were still present on oak. Further observations in field and laboratory indicated that development was more rapid in the first three instars on oak than on the other trees, but that from the fourth instar its rapidity considerably increased on hornbeam, so that the larvae on this tree ultimately overtook those on oak. In the laboratory, mortality was lowest on oak, hornbeam and apple and highest on hawthorn, and there were considerable differences in the physiological condition of larvae feeding on the various trees. Third-instar larvae on hornbeam and hawthorn had lower coefficients of respiration than those on oak, and the nitrogen content was higher in those on hornbeam and apple than in those on oak or hawthorn. In the sixth instar, larvae on oak had the lowest coefficient of respiration and the lowest content of reserve substances, which led to the development of

pupae below the average size and a reduction in the fecundity of the females and in the weight of the eggs laid by them. This is attributed to the rapid hardening of the tissues and the considerable loss of water that accompanies the growth of oak leaves. On the whole, hornbeam was the most favourable food-plant, and apple was second in importance. The food-plants of *L. dispar* recorded in the Russian literature, which are reviewed, indicate considerable geographical differences, but are fairly restricted in number, and the species is therefore not considered to be markedly polyphagous.

An outbreak of the moth was subsiding at the time of the observations, and this was attributed to a physiological weakening of the population associated with forced feeding on unfavourable food-plants and to the effects of polyhedral disease and attack by birds and parasitic insects. Such outbreaks in mountain districts are not likely to last more than 3–4 years.

Shapovalov (A. A.). **Biology and Ecology of *Aegeria apiformis* Clerk. in Forest Shelter Belts.** [*In Russian.*]—*Zool. Zh.* **35** pt. 4 pp. 583–587, 5 refs. Moscow, 1956. (With a Summary in English, suppl. pp. 11–12.)

Poplar is the tree most used in shelter belts in the steppe zones of the Soviet Union. Its most injurious insect pest is *Trochilium* (*Aegeria*) *apiforme* (Cl.), the larvae of which bore in the bark and cambium of the roots and the lower parts of the trunks, causing heavily infested trees to dry up. Observations near Stalingrad and Novocherkassk in 1952–53 showed that the adults were present between 20th June and 7th August and most numerous in the first half of July. Pairing occurred on the trunks, and the females laid up to 2,500 eggs each, which fell to the ground round the trees. The larvae at first fed on the tender external layers of the roots or rootlets and later entered the roots and bored in them and the base of the trunk. They overwintered in the trees and then fed until the end of September or the beginning of October, when they formed cocoons from the frass and overwintered again, in the trees or in the soil, and pupated in the following May. The rate of infestation varied considerably and reached 80–100 per cent. in unmixed stands, and in stands in which the undergrowth produced little litter, but it was low where the undergrowth consisted of broad-leaved plants, which unfavourably affected larval development. Furthermore, species of poplar with well-developed surface roots or delicate bark were more heavily infested than others. Infestation can thus be reduced by selecting suitable species of poplar and encouraging undergrowth. Cocoons in the soil can be destroyed by digging to a depth of 6–8 ins., and the larvae can be controlled by treating the soil and the lower parts of the trunks with BHC in dust form at about 54–72 lb. per acre 2–3 days after the beginning of adult emergence. As a further measure, the trunks can be brushed with a mixture of lime and BHC or DDT.

Savzdarg (É. É.). **Ways of freeing Berry Fruits from Mites in Relation to Peculiarities of their Biology and Ecology.** [*In Russian.*]—*Izv. Timiryazevsk. sel-khoz. Akad.* 1957 pt. 1 (14) pp. 5–19, 10 figs., 49 refs. Moscow, 1957.

Mites are important pests of berry fruits in the central regions of the non-black soil belt of the Soviet Union, particularly in the Moscow district, and investigations on their bionomics and control have been carried out there for some years. *Steneotarsonemus* (*Tarsonemus*) *pallidus* (Banks) infests strawberry throughout its area of cultivation. It had 4–5 generations a year, and heavy infestations caused 70 per cent. or more loss of yield. Reproduction reached its peak in June, when the average daily temperature

rose above 15°C. [59°F.], and coincided with the period of flowering and maximum leaf development. The mites preferred young leaves on shaded parts of the plants and were most abundant in July–August, when their number reached up to 5,000 or more per plant. They became less numerous in September–October, when the temperature fell below 10°C. [50°F.]. The abundance of the mites was also directly correlated with the vigour of the plants, varieties characterised by rapid development and high osmotic pressure being relatively resistant to infestation. Fertilisers applied at high rates increased the osmotic pressure and reduced the damage due to the mite. Heavily infested third- and fourth-year plantings were successfully treated by cutting down the plants immediately after bearing, with simultaneous application of fertilisers, responsive varieties showing 80–93 per cent. increase in yield in the subsequent year. Attempts to develop a method of chemical control were not successful, but tests begun in 1933 showed that runners could be freed from infestation by immersing them for 13–15 minutes in water at a temperature of 45–46°C. [113–114·8°F.] and subsequently cooling them by immersion at 14–16°C. [57·2–60·8°F.]; 75–95 per cent. of the treated plants remained viable. Treatment is best carried out in early spring or autumn, and new plantings should be situated some distance from old ones.

Cecidophyes (*Eriophyes*) *ribis* (Westw.) is a major pest of black currants, on which it causes big-bud and to which it transmits the virus of reversion [*cf. R.A.E.*, A **41** 304, etc.]. Observations showed that it had up to five generations a year, three in summer and autumn and two in spring (May–June), and that the most critical period for both the food-plant and the mite was that of the spring migration, when nymphs, young adult females and a few overwintered females move from the overwintered to the newly developing buds. This began in mid-May and reached its peak during flowering, the number of mites infesting each young bud varying from one to 40. Oviposition in the new buds usually began at the beginning of July. It was renewed after hibernation, when the average number of individuals per infested bud reached 8,000; leaf buds were the most heavily infested. The removal of infested buds gave little control, as they were difficult to distinguish, and the plants reacted to such treatment by increased bud development, which increased their susceptibility to infestation. A spray of 1·5–2 per cent. lime-sulphur applied before the beginning of migration gave good control, but if more than 5–10 per cent. of the buds were infested, 1–2 further applications at an interval of 10–12 days and a concentration of 0·75–1 per cent. were desirable. The use of increased doses of fertilisers decreased infestation, and immersion of the slips in hot water, in the same manner as recommended for strawberry, freed them from the mite.

Tetranychus telarius (L.) (*urticae* Koch) attacks strawberry, raspberry and black currant. It was shown to be suited to a bright, dry environment and preferred older, physiologically weakened leaves. When feeding on mature leaves rich in chlorophyll, the mites mostly damaged the central areas, in which decomposition of saccharose predominates over its synthesis. Varieties characterised by rapid development were shown to be the most susceptible to injury, and cultural practices favouring development increased the infestation.

Ossowski (L. L. J.). **Spraying Experiments with Insecticides against Wattle Bagworm** (*Acanthopsyche junodi* **Heyl.**).—*Rep. Wattle Res. Inst. Univ. Natal 1955–56* pp. 42–45, 1 ref. Pietermaritzburg, 1956.

Since endrin showed promise for the control of *Kotochalia* (*Acanthopsyche*) *junodi* (Heyl.) on wattle [*Acacia*] in South Africa in 1954, it was compared

with toxaphene, the insecticide previously used [*cf. R.A.E.*, A **44** 453, etc.], and other materials in 1955–56. In two pilot experiments, sprays of light diesel oil containing 0·67 oz. endrin, or 1 lb. toxaphene, DDT or RX2 (a commercial preparation consisting of a mixture of allyl derivatives of polyglycerine) per gal. were applied at 3 gals. per acre to trees 10–15 ft. high, and mortality was estimated after 7 and 15 days, respectively. In the first, which was begun on 3rd November, when most of the larvae were in the first two instars, the mean percentage mortalities were 95·2–96·3 for the various sprays, as compared with 36·5 for no treatment, and in the second, which was begun on 20th December, when 80 per cent. of the larvae had reached the third or fourth instar, they were 97·8 for endrin and 91·5–92 for the other materials, as compared with 13·5 for no treatment; endrin was significantly superior to the others in this latter test. In both, rain fell between the times of spraying and sampling.

In large-scale tests, the toxaphene and endrin sprays were applied from the air to trees infested largely by second-instar larvae, and mortality was assessed after 21 days. In plantations 1–1½ years old with an open or interrupted canopy, mortality was complete or almost so for both sprays, as compared with 22·3–29·4 per cent. for no treatment, but it was only 81·5 per cent. for toxaphene and 86·5 per cent. for endrin in a plantation 4 years old with a dense canopy, as compared with 34 per cent. for no treatment. Defoliation of the trees was not prevented in the older plantation, owing to insufficient spray penetration, and the infestation persisted in the following season. Routine commercial spraying in 1955–56 confirmed the high toxicity of endrin to *K. junodi*. Some larvae fell from all the trees during the tests, and counts showed that such individuals were 2–4 times as numerous for treated as for untreated trees.

Convention between the Governments of the United Kingdom, Belgium and France regarding the Supervision and preventive Control of the African Migratory Locust. Paris, May 15, 1952. [*In English and French.*]—*Treaty Series* no. 29 (1957) (Cmd. 128) 11 pp. London, H.M. Stationery Office, 1957. Price 8*d*.

This convention was signed by representatives of the governments of Belgium, France and the United Kingdom on 15th May 1952 and provides for the establishment in Paris of an International Administrative Council for the Supervision and Preventive Control of the African Migratory Locust [*Locusta migratoria migratorioides* (R. & F.)]. The authorities of territories in Africa for the international relations of which the signatory governments are responsible may participate in the convention, and the governments responsible for other African territories affected by the locust may accede to it. The Council is to be composed of representatives of the contracting governments, the participating authorities, or both. One or more International Services to keep under permanent observation the numbers, phase characters, breeding periods and movements of the locusts in the outbreak areas already recognised, to carry out preventive control measures in them, and to investigate the factors that determine multiplication and phase transformation are to be set up by the Council, which is also to assist in controlling swarms that have entered the territories of participating authorities and to undertake research on control methods. The convention is to remain in operation for ten years from the date of its entering into force, after which any contracting government may denounce it or give notification that it shall cease to apply to any of its territories, and such procedure is to take effect after one year. The convention was ratified by the government of the United Kingdom on 17th June 1953, and came into force on 3rd August 1955, on ratification by the last of the three signatory governments.

Priyavratha Rao (S. B.) & Narasimha Rao (D. V.). **Studies on the Sorghum Shoot-borer-fly** *Atherigona indica* **Malloch (Anthomyidae-Diptera) at Siruguppa.**—*Mysore agric. J.* **31** no. 3 pp. 158–174, 1 pl., 3 refs. Bangalore, 1956.

Atherigona indica Mall., the immature stages of which are briefly described, is an important pest of sorghum in an irrigated area at Siruguppa, southern India. Two crops are grown a year, and infestation of the seedlings was found to be heavier, averaging up to 61 per cent. according to variety, in the one sown in September–October, at the end of the rains, than in that sown under restricted irrigation conditions in June–July. The seedlings were attacked up to the age of five weeks [*cf. R.A.E.*, A **44** 72], and the adults oviposited only on the lower surfaces of the leaves, 1–3 eggs being laid per leaf. The larvae hatched in 2–3 days and moved to the central shoots, where they attacked the growing points, causing dead-hearts and the production of tillers, which themselves sometimes became infested. Pupation occurred mostly in the base of the seedlings and very rarely in the soil, and the larval and pupal stages lasted 10–12 and 6–8 days, respectively. Where sorghum is grown extensively throughout the year, the adults appear to confine themselves to it, resting on the earheads and in the leaf-spindles; they were also observed in the spindles of the ratoon crop developing from stubble left in the field, and developing pupae were found in the roots of such plants. Under other conditions, adults were found on other small-grain crops, on tomato plants and occasionally on cotton. There appeared to be no hibernation in the soil, and it seems likely that infestation is carried over from one season to the next by adults sheltering on plants.

Control measures were tested during 1945–54. No effective reduction in infestation resulted from submerging week-old seedlings for 10–30 minutes in water with or without the addition of fish-oil resin soap, or from varying the times of sowing or irrigation, the use of trap crops or an improved grade of seed, dusting with 5 per cent. BHC or DDT, or spraying with 0·05–0·1 per cent. DDT, and similar sprays of BHC applied 1–4 times at ten-day intervals reduced it from 65 to 19–24 per cent. in 1950–51 but were less effective in subsequent years. The optimum time for sowing with respect to yield was mid-September, and intensive manuring with ammonium sulphate or groundnut cake or both, while it tended to increase infestation, is considered desirable since the ensuing vigour of the plants offsets the damage caused by the pest. Tests with varieties of sorghum from India and elsewhere showed that none was completely resistant to *A. indica*, but certain strains from Madras and Bombay showed a fair amount of tolerance. The raising of resistant strains is recommended, together with an increased sowing rate, to compensate for losses due to infestation, and thinning of the month-old seedlings.

Abbas (H. M.), Khan (M. S.) & Haque (H.). **Black Fly of** *Citrus* **(*Aleurocanthus woglumi*, Ashby) in Sind and its Control.**—*Agric. Pakist.* **6** no. 1 pp. 5–23, 11 figs., 18 refs. Karachi, 1955.

A survey in 1953 showed that infestation of *Citrus* by *Aleurocanthus woglumi* Ashby was heavy and widespread in Karachi and other parts of Sind. All stages of this Aleyrodid are described, and its food-plants, world distribution, bionomics [*cf. R.A.E.*, A **35** 187], natural enemies and control are reviewed. It constitutes the most persistent threat to the *Citrus* crop in this area, the larvae and adults sucking the plant juices and a sooty mould (*Capnodium* sp.) developing on the honeydew excreted. Weakening results, and badly affected trees bear neither fruit nor leaves and die.

Losses of 5–10 per cent. are usual, but damage sometimes reaches 50–60 per cent. The Aleyrodid was also found to have spread to mango, mulberry and papaya.

In tests of various proprietary insecticides, sprays were applied to three heavily infested trees each, and population counts were carried out before and three days after application. All the sprays gave complete kill of the adults. Those that also killed all the larvae comprised 10 fl. oz. 46·6 per cent. Folidol [parathion], 1–2 gals. Acrodel (which contains 1 lb. γ BHC per gal.), 300 cc. 50 per cent. malathion, and 12 fl. oz. 23 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] per 100 gals., and the first two of these also killed all the pupae. Endrin, aldrin, dieldrin, Marlate [methoxy-DDT] and weaker BHC sprays were all less effective, but infested trees that were sprayed in 1954 with 3–5 cc. 19·5 per cent. endrin per gal. were saved from complete destruction. Two applications of effective sprays are recommended, the first in June–July, after fruit-setting, and the second during November–December. The natural enemies observed comprised *Amitus* sp., which parasitised the larvae of *Aleurocanthus*, parasitism being low in early December, but rising to 30 per cent. during early February, and various predators, including *Scymnus* sp. and *Semidalis* sp. No species of *Amitus* or *Semidalis* were hitherto known from Pakistan.

Deputy (O. D.). **A Handbook on the Principles of Plant Quarantine Enforcement for Indonesia.**—*Contr. gen. agric. Res. Sta. Bogor* no. 146, [1 +] 165 pp., many figs., 22 refs. Bogor, 1957.

This handbook is based on a training course in plant quarantine given by the author in Indonesia and consists of a general analysis of the principles and practice of the subject, with adaptations for local conditions, followed by some consideration of the insects most likely to be encountered in plant-quarantine work, illustrated keys for their identification in the adult or larval stage, and a glossary of technical terms.

Lever (R. J. A. W.). **Rearing and Liberation of Tachinid Parasites of Padi Stem-borers in Malaya.**—*Malay. agric. J.* **39** no. 1 pp. 40–47, 6 figs., 5 refs. Kuala Lumpur, 1956.

An attempt to introduce *Paratheresia claripalpis* (Wulp) from Trinidad to Malaya for the control of stem-borers in rice was begun in 1951, when 20 consignments of puparia were received between early April and the end of July. The puparia were sent by air in celluloid vials containing damp moss and cotton-wool, and usually arrived in 9–11 days, though three consignments were 37–45 days in transit; adults nevertheless emerged from 40 per cent. of the puparia in two of these. The parasite was reared in the laboratory, by techniques that are described [*cf. R.A.E.*, A **32** 342], on *Chilotraea polychrysa* (Meyr.), which is the most important of the borers present, and *Chilo suppressalis* (Wlk.), though mortality among the fertilised females was high [*cf. loc. cit.*]. Parasite larvae were dissected from the parent females 8–10 days after the latter had been fertilised and were placed on almost half-grown host larvae. Development in *Chilotraea polychrysa* occupied 8–14 days, and the pupal stage, outside the host, lasted a further 14 days. An attempt to rear the parasite on *Sesamia inferens* (Wlk.) was unsuccessful.

In view of the results of these preliminary tests, further consignments of puparia were obtained from Trinidad in 1952, kept in the laboratory until emergence began, and then sent, usually by rail, to an isolated area in

Province Wellesley for release. The area selected was one in which two rice crops are grown each year and borer infestation is normally heavy. Over 8,000 parasites were released over a period of six months; unfortunately, the rice was not in a stage favourable for infestation by borers, owing to adverse weather, but *Scirpus grossus* and various grasses were present as alternative food-plants. Attempts to recover the parasite by collecting infested rice stems in 1952, 1953 and early 1955 were unsuccessful. *C. polychrysa* represented 90 per cent. of the borers found in November 1952, but only 10·5 per cent. in March 1953, when *Schoenobius incertulas* (Wlk.) comprised 58 per cent. of the population. Collections of flies taken on rice or in flight included no examples of *P. claripalpis*, but several of *Sarcophaga dux scopariiformis* Senior-White and *S. calicifera* Boettch., of which the latter, together with *Sturmiopsis inferens* Tns. (*semiberbis* (Bezzi)), was reared from larvae of *C. polychrysa*. Larvae of *C. polychrysa* were observed to be attacked in rice stems by larvae of *Tabanus striatus* F., and in investigations one of these consumed five in three weeks and another six in a month.

Puparia of *Metagonistylum minense* Tns. were also received in 1951, but the fertilised females usually died within five days.

Boyle (W. W.) & Haramoto (F. H.). **Cyclamen Mite on Pikake.**—*Hawaii Fm Sci.* **5** no. 2 pp. 1, 7–8, 4 figs. Honolulu, 1956.

Stenotarsonemus pallidus (Banks), which has been present for some years in Hawaii, was found in March 1956 on pikake (*Jasminum sambac*) grown commercially on Oahu. Notes are given on the bionomics of the mite [*cf. R.A.E.*, A **5** 507]; it reproduces throughout the year in Hawaii and infests the leaf and flower buds of the plants, causing deformation and reducing flower production. It is sometimes accompanied by *Hemitarsonemus latus* (Banks), and characters are given by which the two can be differentiated.

Control of *S. pallidus* is difficult because of the protection afforded by the buds. In a spray test, in which five applications were made at ten-day intervals in March–April, 2 lb. 10 per cent. wettable endrin, 2 lb. 25 per cent. wettable parathion and 2 U.S. quarts Metacide [a mixture of methyl-parathion and parathion] per 100 U.S. gals. resulted in 49·1, 50 and 61·6 per cent. infested shoots and in 308, 453 and 371 living adults per 120 shoots, respectively, as compared with 91·6 per cent. infested shoots and 1,377 adult mites for no treatment. Metacide and parathion caused yellowing of the leaves, but endrin was not phytotoxic. The same toxicants applied at half the concentration gave significantly poorer results.

Johnson (J. C.). **Pod Twist: a previously unrecorded bacterial Disease of French Bean** (*Phaseolus vulgaris* **L.**).—*Qd J. agric. Sci.* **13** no. 3 pp. 127–158, 14 figs., 11 refs. 1956; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 96, 32 pp., 14 figs., 11 refs. Brisbane, 1957.

The bacterial disease referred to as pod twist was observed for the first time in French beans grown in Queensland in 1951. It was found to be caused by a species of *Pseudomonas* for which the name *P. flectens*, sp. n., is proposed, and the properties of this bacterium and the symptoms that it causes are described in detail. The disease was subsequently found to be widely distributed in the State and had apparently been present for at least ten years. In the laboratory, the bacterium was transmitted to beans by inoculation, and symptoms also developed in pods of the wild *Phaseolus lathyroides* and lupin. Some evidence was obtained that a crop of beans

had become infected from plants of *P. lathyroides* growing abundantly nearby, and natural infection in *P. lathyroides* was subsequently found to be widespread. All the infected crops of beans were observed to be infested by thrips, and as peak infection occurred at times when the thrips populations were high, the ability of these insects to transmit it was investigated. Several species were collected on infected crops, but *Taeniothrips nigricornis* (Schmutz) was the only one commonly present, and it was also abundant on *P. lathyroides*. When thrips of this species from infected beans or *P. lathyroides* were confined on bean plants in flower under insect-proof cages, symptoms resembling those in infected field crops developed in 8–13 days and the bacterium was isolated from nearly all the plants. *P. lathyroides* flowers throughout the summer, and is able to provide a continuous source of infection, which would explain the occurrence of the disease in bean crops well isolated from other bean-growing areas.

Wallace (M. M. H.). **A rapid Method of sampling small free-living Pasture Insects and Mites.**—*J. Aust. Inst. agric. Sci.* **22** no. 4 pp. 283–284, 3 figs., 1 ref. Sydney, 1956.

The apparatus described was devised for the rapid sampling of *Halotydeus destructor* (Tucker) and *Sminthurus viridis* (L.) in pastures in Western Australia, where populations of these pests sometimes reach very high densities. A galvanised iron cylinder, 4 ins. in diameter, is used to remove a core of soil about 2 ins. in depth, which is then sieved through fly-wire gauze stretched across the inside of a metal funnel, 6 ins. in diameter and supported on a wooden frame. The organisms fall into a small plastic tube fastened over the neck of the funnel by a rubber collar, and virtually all are recovered in this way. The organisms are later scattered over trays painted chocolate brown or dark blue to facilitate their detection, and counted by means of an aspirator. This method enables one person to collect up to 100 samples in less than an hour, the time varying with the softness of the soil. In general, it is not suitable for dry or very sandy soils, which fall through the funnel.

Martyn (E. J.). **Further Experiments on the insecticidal Control of the Corbie, *Oncopera intricata* Walker.**—*Tasm. J. Agric.* **27** no. 3 pp. 287–290, 4 refs. Hobart, 1956.

Earlier investigations showed that DDT applied to pastures in dusts or combined with fertilisers was effective in controlling *Oncopera intricata* Wlk. in Tasmania [*cf. R.A.E.*, A **41** 125], but when low-volume spraying equipment became more available, tests were made to determine the value of sprays. In 1952, sprays of aldrin and dieldrin applied to experimental plots at 1 lb. active ingredient per acre on 25th September were ineffective, but a spray of DDT at the same rate reduced infestation from eight to one larva per sq. ft. by early November. In 1954, DDT applied on 22nd September and 4th October gave very highly significant reductions in larval populations at a rate of 1 lb. per acre and, when applied in September, a significant reduction at 0·5 lb. per acre, but was ineffective at 0·5 lb. on the later date or at 0·25 lb. on either. The early spray at 1 lb. per acre was less effective than the one applied at about the same date in 1952, and this is attributed to the presence in the pasture of dense patches of subterranean clover [*Trifolium subterraneum*], which impeded the penetration of the spray to the lower parts of the grass on which the larvae feed first, whereas grass comprised 80–90 per cent. of the pasture in 1952.

Millán (E.). **Metamorfosis y ecología de *Aphidius platensis* Brèthes (Hymenoptera: Aphidiidae).** [Metamorphosis and Ecology of *A. platensis*.]—*Rev. Invest. agric.* **10** no. 3 pp. 243–280, 16 figs., 41 refs. Buenos Aires, 1956.

Aphidius platensis Brèth., of which *A. porteri* Brèth. [*R.A.E.*, A **4** 466] is a synonym, is a well known parasite of *Toxoptera* (*Schizaphis*) *graminum* (Rond.) on cereals in Argentina and Uruguay and is recorded from peach Aphids in Chile and Brazil. The author describes all stages and the developmental cycle of this Aphidiid, gives lists of its alternative hosts, and reviews, largely from the literature, its synonymy, bionomics and natural enemies, and attempts made to increase its effectiveness against *T. graminum* by release of additional material [*cf.* **36** 50; **41** 117, etc.]. In laboratory observations in Argentina, newly emerged males lived for four days and females for 5–6 days in October–November, females were found to contain 60–127 eggs in each of their two ovaries, though the total egg-production could not be ascertained, and the complete life-cycle lasted 17 days in October.

Hering (E. M.). **Bestimmungstabellen der Blattminen von Europa einschliesslich des Mittelmeerbeckens und der Kanarischen Inseln. Band I.** [Keys to the Leaf Mines of Europe including the Mediterranean Basin and the Canary Islands. Vol. I.]—pp. 1–648. **Band II.**—pp. 649–1185. **Band III.**—221 pp., 86 pls. (725 figs.). The Hague, Dr. W. Junk, 1957. Price (3 vols.) unbound 180 *gld.*

The geographic area covered by this work comprises the whole of Europe, North Africa (including the Canary Islands) and Asia Minor, so far as information is available. The first two volumes consist of keys to the insects that mine in the leaves of plants, arranged under the generic names of the plants and based chiefly on the nature of the mines, the arrangement of the frass pellets or simple characters of the insects or their remains found in them, with brief descriptions of the mines and sometimes notes on the insects concerned and their world distribution. The second volume includes a list of the German popular names of the plant genera and an index to the insects. The third volume opens with descriptions of new species included in the keys, and of several species that have been misidentified, followed by systematic lists of the plants and insects, but consists principally of figures illustrating the mines in different plants and sometimes characters of the insects themselves.

Papers noticed by Title only.

Glen (R.). **Entomology in Canada up to 1956. A Review of Developments and Accomplishments.**—*Canad. Ent.* **88** no. 7 pp. 290–371, many refs. Ottawa, 1956.

Gambrell (F. L.) & Gilmer (R. M.). **Insects and Diseases of Fruit Nursery Stocks and their Control** [in New York].—*Bull. Cornell agric. Exp. Sta.* no. 776, 50 pp., 23 figs., 24 refs. Geneva, N.Y., 1956.

Rings (R. W.). **Insect and Mite Pests of Peaches in Ohio.**—*Res. Bull. Ohio agric. Exp. Sta.* no. 768, 48 pp., 36 figs., 32 refs. Wooster, Ohio, 1956.

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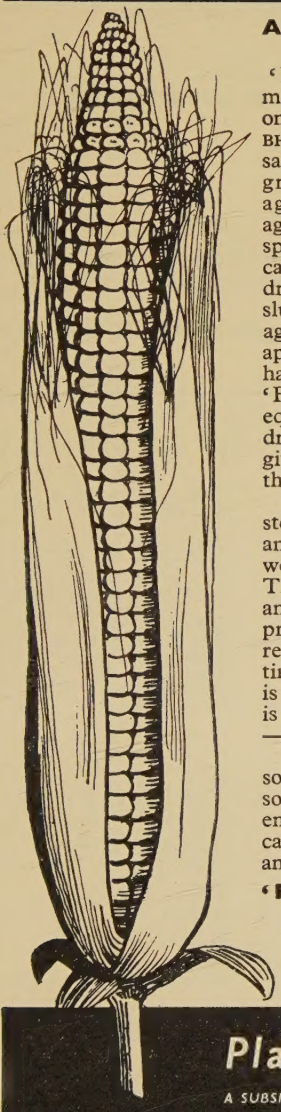

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'Fernasan' 75W is a non-mercurial seed dressing based on thiram (TMTD) and gamma-BHC (lindane). It keeps seed safe in store and safe in the ground. It protects seed against insect pests *and* against soil-borne fungi. It is specially formulated so that it can be used either as a dry seed dressing or as a slurry. The slurry method has the advantage of eliminating dust during application. If you do not have a slurry seed treater, 'Fernasan' 75W can be applied equally well in a drum-type dresser or any machine that gives adequate distribution on the seed.

'Fernasan' 75W protects stored seed against moulds and insect pests such as grain weevils, moths, and their larvæ. The seed can be dressed at any time when the weather prevents outdoor work and it remains safe until sowing time. No second application is needed. Double protection is given with only one dressing — a great saving in cost.

'Fernasan' 75W protects sown seed against decay in the soil and fungi that cause pre-emergence damping off, a cause of reduced germination and loss of vigour.

'Fernasan' 75W is concentrated

'Fernasan' 75W is very concentrated. As a result, the amount of dressing needed per seed is small and there is less chance of the protective covering being shaken off the seed in the course of handling.

Seed Storage

Seed treated with 'Fernasan' 75W can be safely stored for a period of up to twelve months provided that the initial germination capacity is high, the moisture content below 16% and the storage conditions satisfactory.

Use it for:

MAIZE · PEAS · BEANS · SWEET CORN · SORGHUM · JUTE · MILLET GROUNDNUTS · CARROTS BRASSICAE · LETTUCE · CUCURBITS SPINACH · BEET · SUGAR BEET FLAX

How to use it

Slurry Dressing: The amount of dressing recommended for dry application should be mixed with one pint of water and used to treat 100 lb. seed.

Dry Dressing: Any method which ensures even mixing of seed and dressing. On a small scale, mixing in a drum or shaking in a jar for 3 mins. will give adequate coverage. For treating large quantities a seed dressing machine should be used.

Dressed seed should not be fed to livestock

Plant Protection Ltd

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A CRITICAL REVIEW

of the World Literature on

THE LEPIDOPTEROUS STALK BORERS OF TROPICAL GRAMINACEOUS CROPS

By W. F. JEPSON, O.B.E., Ph.D.

Roy. 8vo. pp. vi and 127. Paper Covers. Price 15s. ($2.25). Post Free.

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1. Historical
2. Systematic characters in the identification of the adults
3. Host range of the stalk borers and host-plants of economic importance
4. Bionomics
5. Population estimation and damage assessment
6. Relation of stalk borers to cultural practices
7. Parasites, predators and diseases
8. Control

Conclusions and recommendations for future research are given and a long list of the references mentioned in the text. There is also an index to names of insects and one to names of plants.

Orders should be addressed to The Director, Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.

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